ENGINEERING NEWS

WORK on the Chicago Lake tunnel, which was somewhat interrupted by the striking of an immense bed of quicksand at the shaft from which the tunnel was to have started, is now progressing rapidly. The new shaft for the beginning of the lake tunnel is completed, the ground being in good condition to the full depth. Work on the land tunnels is being pushed at many points, one branch having reached a point 1400 ft. from the place of beginning, and another having been extended 800 ft. Some delay was occasioned by a scarcity of hand-made brick, called for by the specifications, but a supply has been procured and work resumed. The intermediate crib, to be located 2½ miles from the shore, is in course of construction. This is to consist of two cylinders with diameters of 30 and 75 ft., and weighing respectively 200 and 300 tons, and both 50 ft. high. When in position the smaller one will be within the larger, the intermediate space being filled with concrete, sand and stones. The crib will project about 10 ft. above the surface of the water, which is here 38 ft. deep. The cylinders will be put together, and dropped into the water on end near the shore between two good sized schooners. They will then be lifted, towed out and dropped into position. It is thought that this may be accomplished during July.

THE Niagara Reservation Commissioners have recommended the construction of an embellished roadway from the reservation down the river to the whirlpool rapids, and the construction of a bridge across the river just below the whirlpool. Such a road and bridge would offer the best possible opportunities for seeing the fall and river to advantage. State Engineer BOGART has been requested to have surveys made and maps prepared, and to select the most desirable location for the bridge.

SENATOR CHANDLER has introduced a bill to provide for the construction of the Lake Borgne outlet to improve the low water navigation of the Mississippi river from New Orleans, La., to Cairo, Ill., and incidentally to reclaim and protect the valley land of the Mississippi river and tributaries from overflow. This is the celebrated COWDON outlet scheme. As compensation for the work COWDON is to receive $500,000 per ft. for each foot that the flood line of the Mississippi shall be lowered at New Orleans, Vicksburg, Helena, Memphis, the mouth of the Red River, and Cairo, within 60 days after the outlet shall have been opened.

THE Brooklyn Bridge management has been having trouble with the new cable machinery it recently put in, with which it was hoped the traffic capacity of the bridge railway could be increased to the extent of running 4-car trains instead of 3-car. The first attempt to start the machinery resulted in a failure, but after some slight changes it was got in motion and run for somewhat over an hour, when the journals became heated and it had to be stopped. Just about this time the old cable broke, and had to be replaced by a new one, the operation consuming more than half of an entire day, during which the trains were run at long intervals by locomotives. Several stops have since occurred when the cables have been changed, the change requiring about an hour and a half to effect. It was noticed that the new cables began to stretch with use and the old cable was accordingly repaired and put into commission with a patch of about 200 ft. of new cable inserted, but this did not work, and the old cable had to be taken out of commission entirely. The new cables were worked alternately for a time, when it was found that the slack of the new cable on the new machinery was cutting out the grooves of the horizontal guide wheels in the Brooklyn station, and a change to the new cable on the old machinery became necessary. But both cables have stretched to an unforeseen degree and will in all probability have to be cut and a piece be taken out of them.

WE must acknowledge a slip of the pen in last week's issue, in fixing the death of ALEXANDER L. HOLLEY at the age of 35 instead of 50 years, as he was born in 1832 and died in 1882. Mr. HOLLEY was so full of life and energy and so young in appearance that those who knew him will appreciate our slip in dates.

NATURAL gas is reported to have been found at Sparta, Ill., and at Shreveport, La. At Sparta it is estimated that the flow of gas per 24 hours is between 3,000,000 and 4,000,000 cu. ft. The gas is said to burn with a rich yellow flame, making it of value for illumination.

In drilling the well the first evidences of gas were detected at a depth of 845 ft. and at a slightly greater depth a body under great pressure was reached. We give herewith the record of the different strata passed through in drilling the well, which is taken from the St. Louis *Globe-Democrat*.

	Depth.	Feet Thick.		Depth.	Feet Thick.
Soil	0	30	Limestone	370	15
Quicksand	30	4	Slate	385	13
Gray sandstone	34	30	Limestone, hard.	398	5
Soft shale	64	35	Sandstone	403	25
Shale and lime	99	18	Slate	428	10
Solid gray lime	107	1	Sandstone	438	40
Coal and shale	118	6	Slate	478	8
Gray limestone	124	8	Limestone	486	44
Soft shale	132	8	Slate	530	46
Lime	140	10	Sandstone	576	30
Black slate	150	25	Soapstone	606	104
Gray limestone	175	5	Limestone	710	20
Small vein coal	180	2	Light shale	730	35
Light shale	182	35	Dark red slate	765	15
Coal	217	3	Limestone	780	18
Soapstone	220	45	Slate	798	22
Lime & sandstone	265	20	Limestone	820	13
Slate	285	35	Light shale	833	12
Sandstone	320	10	Limestone	850	5
Soapstone	330	40			

IT is reported that Boston capitalists have formed a company with a capital stock of $500,000, for the manufacture of electric welding machines. These machines will be sold, but the company will have a royalty on every weld made. A meter, said to be so constructed that it will only register a perfect weld, will be attached to each machine and keep the record. It is stated that this company is buying up all the methods of electric welding now known or being experimented with.

AT a citizens mass meeting held at Sault Ste. Marie, Mich., on the evening of July 4, the $12,000 needed to insure the commencement of the water power canal was raised. This makes the total subscription of the citizens of Sault Ste. Marie $100,000, for which they are to receive $200,000 worth of stock from the water power company. The total cost of the canal is estimated at $700,000. It will be three miles long; it is expected that work will be begun as soon as the contractors can get their machinery on the ground, and that the work will require 15 months for its completion. The project was started about two years ago. Many manufacturers are making arrangements to use the power, and residents of Sault Ste. Marie have great hopes of the, towns becoming a manufacturing centre on account of the water power.

AN alleged new process of extracting aluminium which is claimed to make the metal "as cheap as copper" is reported from Newport, Ky. The rather vague descriptions of it state:

> The method is based upon the theory of substitution and smelting the ore in a water-jacketed steel furnace, a crucible being useless to resist the strong fluoride fluxes. When the mass is quite liquid, it is conveyed into a converter or covered slag pot holding about 400 pounds, and the aluminium extracted therefrom by a syphon tap. The slag is returned to the furnace, serving the purpose of a flux, with more ore. This direct continuous process obviates the necessity of the usual costly intermediary elements, and makes the aluminium about as cheap as copper.

The presumptions are all against the truth of the reports, but such a discovery may come any time; and such reports have special interest because when it does come it will revolutionize metallurgy.

THE *Zeitschrift für Transportwesen und Strassenbau* gives the following statistics of the Berlin city traffic.

On Jan. 1 of this year there were in use 918 horse-cars, and 5,290 cabs, omnibuses, etc., an increase of about 4½ per cent. in the year. The drivers, conductors, etc., employed in this traffic numbered in all 13,292; the horses, 13,466. At the end of the year 1886 the total length of horse-car track was 154 miles.

Many attempts have been made to introduce locomotives in place of horses for drawing the cars on the surface railways, but at present only one small road (about 2½ miles in length) is operated by this means. In this case the "Rowan" system has been adopted.

Following is a list of the number of passengers carried within the limits of the city, by the different means of transportation:

	Passengers.
Berlin City Elevated and "Belt" Railways	16,244,575
Omnibuses	18,642,980
Berlin and Charlottenburg Horse Railway	4,255,106
Great Berlin Horse Railway	85,500,000
New Berlin " "	6,949,718
Steam Street Railway	515,264
Total	132,107,623

This is a large aggregate for a European city.

THE most serious railway accident of the week was a head collision July 17, on the Louisville & Nashville Railroad, at Shades Creek, near Birmingham, Ala. A north bound express train collided with a south bound extra freight train, which was running out of time. Two men were killed and several injured. Both trains were badly wrecked. These "extra" freights are a constant element of danger and are the cause of continual accidents on single and double track roads alike.

DURING the week, floods and storms have caused considerable damage in Southern Pennsylvania and West Virginia. The Monongahela river has flooded large tracts of land. Severe storms have also occurred in New England. Washouts have occurred on the Hocking Valley and Fort Worth & Denver railways. Slight earthquake shocks were experienced in Ontario and at sea off Cape May, N. J., on July 9.

THE new part of the canal bank at Adams Basin, near Buffalo, N. Y., which was built to repair the break of July 7, was carried away July 16, when water was let into the basin. The break was 15 ft. wide and extended to the bottom of the canal.

THE following bridge accidents are reported: On July 13, a Northern Pacific passenger train went through a small bridge near Forsythe, Mont., and 5 or 6 persons were injured. The structure had been weakened by recent rains.—On July 13, a Georgia Pacific freight train went through a trestle near Coalburg, Ala.; 5 or 6 men were injured.—On July 14, the Eel river bridge, near North Manchester, Ind., on the Cincinnati, Wabash & Michigan road, gave way under a train. The bridge and wrecked cars were burnt.—On July 14, a Fort Worth & Denver passenger train went through a bridge or trestle near Clarendon, Tex. The structure had been damaged by a washout.

THE war in east bound freight rates on dressed beef has come to a standstill with a rate of 6 cts. per 100 lbs. on dressed beef between Chicago and New York, in force as the tariff of the Erie and the Chicago & Atlantic. When it is remembered that 65 cts. was the rate in force when the war began, the extent of the cuts can be appreciated. The Pennsylvania and Vanderbilt lines are carrying most of the dressed beef, however, at 7 cts.; the roads which made the six cent rate having notified shippers that on account of low rates their meat would have to go by ordinary freight trains. Live stock rates by the Vanderbilt lines are 5½ cts. between Chicago and New York. The Pennsylvania went as low as 5 cts. to New York, 3 cts. to Philadelphia, and 2 cts. to Baltimore, and then stopped. The Grand Trunk, Lackawanna and Nickel Plate have advanced their dressed beef rate to 30 cts. But the Pennsylvania and Vanderbilt still show no intentions of putting rates back to a paying basis. Rates on many other classes of freight are being cut, and the fight is plainly not yet over.

THE new Argentine Pacific Railway, from Buenos Ayres to the foot of the Andes, has a tangent on it 211 miles long, which is supposed to be the longest straight piece of railway in the world. In this distance there is not a single bridge, and no opening larger than an ordinary culvert. The level nature of the country is shown by the fact that on this line there is neither cut nor fill exceeding 3 ft. in depth. On account of the absence of timber, metal ties are being extensively used.

The Theory of Earthquakes.

BY RUDOLF FALB.*

[Translated for ENGINEERING NEWS by F. G. LIPPERT].

(*Continued from page 29.*)

The Continuation of Shocks.—It is a remarkable, yet invariable fact that every catastrophic shock is followed by a succession of lighter shocks returning with diminishing force and frequency, and ceasing in most cases only after several months. Thus we read invariably in the papers, for weeks after a catastrophe, news despatches like this: "Light earthquake shocks continue still." This circumstance seems all the more striking, as light shocks in advance of a catastrophe have been reported in but few cases, and then only one or two shocks immediately or a few hours prior to the same. Little dependence, however, is to be placed upon assertions of that kind, coming as they generally do from a few persons only, so that we may safely assume the law to be this: *that the main shock stands at the beginning of the series.* This is much to be deplored, for, if any lighter shocks preceded a catasprophe, they might be taken as a timely warning, saving untold human lives. The entire chronicle of earthquakes, however, does not contain one single instance of such saving of life among the hundreds of catastrophes.

For finding the causes of earthquakes, it is of importance *to note the date* on which the severest one out of a series of secondary shocks occurred, shocks that are felt not only at the center, but all around the disturbed area. This involves no difficulty, as the extent of the undulations, *i. e.* the distance at which the shock was felt, enables the observer to estimate the relative force of such shocks. It is this repetition of the catastrophe in a milder form, which is usually characterized in the newspaper accounts by the term "a new panic." But we do not know of one single instance in which a secondary shock had reached, even approximately, the force or, in other words, the widespread effect of the first or main shock. We are therefore justified in emphasizing the following as the second law governing earthquakes, that *in one and the same series of earthquake shocks a second catastrophe does not take place* either at the center or in its surroundings.

Upon the two laws above quoted, the author lays all the greater stress, since they have hitherto escaped the attention of investigators.

By noting the dates on which the severest of all secondary shocks took place, it has been found that *they are identical with the days on which occur the greatest tidal attractions of the moon, following a catastrophe.* To cite a few examples of recent date, this is precisely what happened in connection with the earthquake shocks in the valley of the Visp, Canton Wallis, Switzerland (1855), on Sept. 24, Oct. 27 (the latter three days after a lunar eclipse) and Nov. 12, (three days after a solar eclipse.) The same day, the catastrophe of Yeddo, Japan, occurred, in which 30,000 people perished. Similar coincidences are to be noted in connection with the earthquakes of Belluno, Italy (1873) on Aug. 8 and Dec. 25; the earthquake of Tarapaca (1878) on Feb. 20, three days after an eclipse of the moon; at Agrams Croatia (1880) on Dec. 16, simultaneously with a lunar eclipse; in Andalusia (1885) on Feb 27; at Kindborg, Styria (1885) on Sept. 22, two days in advance of a lunar eclipse; at Charleston, South Carolina (1887) on Feb. 7, one day after a lunar eclipse; in the Riviera (1887) on March 11; at Werny (1887) on June 20 and Aug. 22, the latter three days after an eclipse of the sun.

Distribution of Earthquakes as to Locality.—It is a fact which has never been contested, that the great majority of earthquakes and the most powerful occur, first, in the vicinity of volcanoes, either active or extinct; secondly, in regions of great mountain ranges. Apparently this might lead us to distinguish between volcanic and non-volcanic shocks; but it would be a mistake to extend that distinction to the causes of earthquake shocks, for the simple reason that volcanoes covered and imbedded, in the course of thousands of years, by sedimentary formations, may exist under localities showing at the surface no visible traces whatever of a volcanic nature.

Distribution of Earthquakes as to Time.—As early as thirty years ago M. ALEXIS PERRY, a French scientist of Dijon, furnished proof that earthquake shocks occur more frequently:

1. At the time of the perigee of the moon.
2. At the time of the syzygies (full and new moon) and,
3. In the colder half of the year.

Independently thereof, twenty years ago, the author came to the conclusion that the *greatest number and the severest of earthquakes occur at the time when certain factors of tides coincide, i. e., those positions of sun and moon which cause an increased tidal attraction.*

These factors of tides are:

1. Perigee and equatorial position of the moon.
2. Perigee and equatorial position of the sun.
3. Full and new moon, (syzygy.)
4. Eclipses of moon and sun.

Moreover, by a careful count of the cases noted in Robert Mallet's Catalogue of Earthquakes, extending from the year 800 B. C. till 1843, the author found that in that space of time earthquakes took place on 5,492 days, the largest number of which came during January, April and October, the smallest in July and August. Somewhat later Dr. JULIUS SCHMIDT, director in charge of the astronomical observatory at Athens, Greece, was invited by the author to make some investigations as to the relations of the frequency of earthquakes to the positions of sun and moon, which have yielded this result: that earthquakes occur more frequently, (1.) when the moon is in perigee than when she stands in apogee, (2) more frequently at the time of new moon than at the first quarter, and likewise more frequently at full moon than at the last quarter. Still more striking is the concurrence of his results with those of the author as to the distribution of earthquakes during the year, for Dr. Schmidt finds a maximum in January, March and October, a minimum at the beginning of July. In other words, the greatest frequency at the time of perigee of the sun and equatorial position; the least at the time of apogee, which occurs July 1. This same law governing the distribution of earthquakes during the year, the author found corroborated by the notes kept by the people of Copiapo, Chile, on the earthquakes which so frequently visit that region. Those notes indicate a maximum of earthquakes for the months of January and October. This fact is sustained also by a list of the earthquakes in Switzerland generally, the canton of Wallis in particular, and by the chronicle of earthquakes kept by the town of Bâle. A doubt about the law of periodicity, therefore, is no longer admissible.

As the sun occupies his equatorial position on March 21 and September 23, exerting then his greatest tidal attraction, the coincidence of effective lunar positions at the time of the equinoxes, assisted by the sun, might be expected to produce great results.

Conclusion.—Theory of Earthquakes.—In summing up all the above facts we reach the following résumé: The distribution of earthquakes in general, and the course of secondary shocks in particular, their dependence upon certain positions of the moon to earth and sun, as well as certain positions of sun to earth, all this proves to us exactly and satisfactorily that we have to deal here with a *tidal phenomenon.* What the author here pronounces as a theory M. PERRY had put forward as a conjecture, without, as he himself confesses, having attempted to carry through a physical solution of the question, or, in other words, to adduce the proofs necessary for a theory. For a theory does not merely consist in a scientific hypothesis, but in the grouping together of all the observed facts, and in the examination and criticism of that hypothesis by means of said facts. A hypothesis is simply an assumption; a theory, on the other hand, is a solid structure built up in accordance with the rules of logic, and embodying all the facts of the case, uniting the different parts in a harmonious whole. That the author was enabled to carry such a structure to completion is owing, on the one hand, to a consistent application of his tidal theory to the phenomenon of earthquakes; on the other hand, to taking into account all the facts, especially the two laws hitherto unnoticed, viz: that "every catastrophe is followed by a succession of shocks," and that 'none of the subsequent shocks reach the force of the catastrophic shock."

When it is conceded that frequency and force earthquakes are in proportion to the theoretical tidal attractions exerted by moon and sun, the question next arises: What is here the flowing matter, and further, what connection exists between it and the mechanical shocks of the ground?

Granting the interior of the earth still to be partly in the state of a thick liquid mass, it might be assumed that a tidal wave would form in the earth's interior, analogous to that formed in the ocean, striking at the time of the spring tides, against the solid crust of the earth, and thereby causing earthquake shocks. This view, towards which M. PERRY inclined, and which the author formerly took in consideration, proved itself, however, to be untenable, when the character of a catastrophic shock and the subsequent course of successive shocks were carefully considered. A great lava-wave travelling along under the earth's crust and striking the latter, ought to be recognizable by a track of destruction having the form of a broad zone running from east to west. It could not cause destruction over an area circular in shape with a distinct central point; and yet this it does invariably. Besides, those secondary shocks, limited as they are to the center of the area, cannot be accounted for at all by this assumption. The author was put on the right track for solving this interesting question, by the eruption of Mount Ætna in 1874. Expecting the said event to occur on Aug. 27, he spent that entire month on the island of Sicily. The eruption did actually take place on Aug. 29. 27 hours after the eruption, several single shocks occurred, and again, 16 hours later, numerous shocks, none of them however leading to a catastrophe. The said eruption took place on a day when the moon's perigee coincided with her equatorial position, and two days after a full moon; hence, at a time fully corresponding to the tidal theory.

As these secondary shocks bore entirely the character of those secondary shocks which we observe after each and every catastrophe, I was looking forward with great eagerness to the next period of spring tides which was to be due on Sept. 25 and 26, on account of full moon of Sept. 25, and perigee and equatorial position on Sept. 26. I had gone to Naples three days after the eruption and had not read of any further shocks for some time, when suddenly telegrams appeared in the papers announcing that on Sept. 26 a violent earthquake had occurred at the foot of Mount Ætna, surpassing in force all former shocks. Several houses were reported cracked, a general panic broken out and Mount Ætna roaring. As these shocks, according to the general conviction of all investigators, could only emanate from the subterranean lava which had already displayed its sensitiveness to lunar attraction, by the eruption taking place at the period of theoretical high-tide, it became clear to me that *the character of an earthquake catastrophe differs in no wise from that of a volcanic eruption; that the two phenomena are identical to the extent that the catastrophe of an earthquake is nothing but a volcanic eruption taking place at considerable depth under the earth's surface.* There remained, however, two questions for me to answer, viz.: Frst, did the state of commotion of the lava in the interior of the earth, existing at the time of the eruption of Mt. Ætna, prove itself by earthquake shocks at far distant places, to have been a general one, as the tidal attraction of the moon would require? Second, how are secondary shocks to be accounted for?

Regarding the first one of my questions, it is certainly a striking fact that on Aug. 25, earthquake shocks were felt at Nasram, on the northern slope of the Caucasus, of such force that chimneys

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* Herr RUDOLF FALB, who has attracted general attention by his paper on the theory of earthquakes, which we here translate, was born April 13, 1838, in Obdach, Styria. He studied for the priesthood and officiated as a Catholic priest for two years, and then turned his attention to mathematics, physics and astronomy. In 1866, he founded the astronomical journal, *Sirius*, which he has ever since conducted. In 1870 appeared his *Principles of a Theory of Earthquakes and Volcanic Eruptions.* After a protracted stay at Vienna, for the purpose of studying geology at the *Polytechnikum*, Herr FALB set out for South America to investigate volcanic phenomena and, at the same time, to pursue archæological studies. As a result, he published his book: *The Land of the Incas, its Relations to the Primeval History of Language*, and another work; *The Language of the Andes.*

Herr FALB, who, some 15 years ago, became a Protestant, now resides at Leipzig. He has drawn public attention to the results of his learned researches, and made them popular, by lecturing in many of the more prominent cities of Europe.

were thrown to the ground; that this shock was followed by numerous lighter shocks,and further, that on Aug. 26, an earthquake took place on the island of Porto Rico in the West Indies, causing houses to totter. The most convincing proof, however, for the connection existing between the condition of the lava inside Mount Ætna on one hand, and earthquake phenomena upon the earth as a whole, on the other, is furnished by the general paroxysm which seized our earth about Oct. 25. that day being noted for the greatest tidal constellation of the year 1874. That constellation, which the author had pointed out in advance, in the March number of his journal "*Sirius*", was distinguished by the following coincidences: Oct. 23, equatorial position of the moon; Oct. 25, perigee, full moon and eclipse of the same; the perigee, too, being the greatest for that year. After a prolonged quiet, shocks occurred again on the northern slope of Mount Ætna on Oct. 23 and 24. At Clana,on the coast, a violent shock on Oct. 24, set everything tottering for three seconds; around Mount Vesuvius earthquake shocks became quite numerous on the same day: two days later, a shock visited distant Yokohama, and the same day a great earthquake shook Chili, lasting 30 seconds, and reaching all the way from Copiapo to Talka.

The second question has hitherto been answered by ascribing the origin of secondary shocks after an eruption simply to a forced suspension of eruptive activity caused by a stopping up of the channel. If that explanation was correct, *i. e.* if the molten lava pressing upward and striking against an obstruction caused those shocks, then the shocks immediately preceding an eruption ought to be the severest and most frequent, as the intensity of the upward pressure is then at its highest point. But this is really never the case; and if the opinion prevailed heretofore, that an eruption announced itself by premonitory earthquake shocks, we must pronounce that belief for which careless reporters and news correspondents ought to be held responsible, to be erroneous. Violent and frequent shocks at the shortest intervals occur *after* an eruption, not *before*. The eruption in nearly all cases takes place suddenly and without any warning, a fact amply attested by the history of Mount Ætna. As with catastrophic earthquake shocks, so also with volcanic eruptions, the assertions made as to precursory shocks are of a character to be distrusted, whilst accounts of subsequent shocks receive general confirmation.

A fitting explanation of the latter kind of shocks is supplied by the behavior of the lava when it is relieved of the pressure of gases resting upon it. The author has had occasion to observe lava in a like condition, and has found his observations to agree with the accounts of other investigators. Out of the mass of lava, gases and vapors are developed, accumulating in the stopped up channel over the top of the lava column, and re-acting by their pressure upon the lava in such a way as to cause the gas bubbles to be discharged gradually and without perceptible shocks. When, however, the channel is clear, the gases escape as fast as they develop. There being no pressure upon the surface of the lava column, the gaseous discharges occur with great violence. Bubble after bubble winds its way through the entire lava column from base to top, each one exploding on reaching the surface, and hurling slag and molten lava up to considerable heights. As the bubbles follow upon each other in rapid succession, these explosions are repeated at short intervals, causing now and then the ground to tremble under the observer's feet, whenever an explosion occurs of excessive force. It is self-evident that here we have to seek the cause for the frequent earthquake shocks following an eruption. So long as the lava column in the cone of the volcano stands above the level of the surrounding plain, so long will the shocks coming from the lava's surface strike the sides of the cone and be felt only by an observer stationed upon the same. As soon as the receding column of lava sinks to points below the level of the plain around the cone, the entire area is made to feel the frequent explosive shocks. That may happen several hours after the eruption, or it may take several days, according to the degree of slowness of the sinking lava and also to the height of the cone above the level country. The said shocks are, therefore, not preparatory to, but a consequence of, the eruption.

When we finally embrace all those characteristic features observed in connection with earthquakes and treated above, in the compass of our conclusion, we are brought to the conviction that *the phenomenon, called a catastrophic earthquake, in all its details, completely resembles what would be observed, if, at a considerable depth under the earth's surface, a volcanic eruption took place*, and that, too, at a spot ever there remaining, becoming charged gradually, discharging at long intervals, and afterward remaining harmless for a long period: stress being laid upon this point, that the date of the catastrophe does not alone depend upon the intensity of the pressure of the lava, but also upon the resistance opposing the final breaking through, a factor beyond the reach of our computations. Experience, however, has shown that the periods of maximum theoretical tidal attraction rarely pass by without some catastrophe.

As regards Germany, the severest earthquakes of recent date, were the shock of March 6, 1872, which made the ground tremble from Creslau to Wiesbaden, and from Hannover to Hechingen, and that of Aug. 26, 1878,which shook an area of more than 2,000 geographical square miles, equal to 42,500 English square miles.

On comparing the constellations which took place on those two days, no one can fail to be convinced of the connection of those shocks with the subterranean spring tides. The constellations occurring were:

1872.	March 5th:	Perigee
"	" 9th:	New Moon
"	" 11th:	Equatorial position
1878.	August 28th:	New Moon
"	" 29th:	Perigee
"	" " :	Equatorial position.

The author hopes he has succeeded in convincing the reader that his theory is not one built upon conjectures, but one grounded on careful physico-mathematical discussion of a voluminous experience, which continues to grow from year to year.

Special Features in Wooden Trestle Work.

MORTISE AND TENON.

There is probably no detail of wooden trestle work over which a more bitter fight of argument has been waged than that of mortise and tenon. The older practice of eastern roads favored it. Later it was laid aside on some roads in favor of dowels or of drift bolts. The latter method is so difficult in repairs that it meets with much opposition for frame trestles. At present the practice tends towards tenon work again, either by mortise and tenon, or by clamps and bearing tenon. The latter has the disadvantage of attempting to ride two horses, the bearing actually being only on the clamp of the large tenon, or on the clamp cap. In the latter case the bearing is carried down, especially in piles, to the outer poorer wood, leaving the more solid interior wood free of duty. This same disadvantage holds good against mortise and tenon work to some extent: but with the smaller tenon used, the balance of bearing area is always in excess of what the post, as a pillar, should sustain. In repairs, the mortise and tenon plan permits sawing and removal of the post, the iron dowel requires a shorter cut and more waste, which may be of moment in some cases.

The two arguments against mortise and tenon that are important are the extra labor in framing and erecting, and the supposed rot at the mortise. The extra labor is not to be considered by a company, if advantages of importance exist favoring the mortise and tenon joint

The question of rotting is more important. It is a more important item in a trestle built in a slovenly manner than in one showing good workmanship. Frequently the top of the sill is not properly surfaced, true and smooth, and the cut of the post about the tenon base is not perpendicular to the post, or is not in one plane but in diverging planes. Hence, an open joint results, into which water may drain and remain in the mortise. With well surfaced work, tenons truly cut, and heavy pressure on the joint, it should be so tight that water should not penetrate so far as to reach the mortise and remain in it to cause rot.

Again the dowel is itself a mortise and tenon, to a certain extent; the argument against rotting would require merely the toed joint.

In favor of the mortise and tenon, if well made, is its prevention of the small initial tendency to sway which is the real agent in injury to the joint, es pecially to a rotting joint. This sway is much more quickly resisted if two pins are used, the stiffness being independent of close work in the mortise.

CAP BOLTING.

Many roads drift-bolt or screw-bolt ach stringer to cap; other prominent roads confine only a part of the number of stringers. In other cases, the splice blocks between stringers are the only connection of any sort between the superstructure and the bent. The second method, in other than pile trestles, especially for high bents, is probably the best practice.

PILE FOUNDATIONS AND PILE APPROACHES IN TRESTLES.

The custom on many roads is to send the pile drivers over the line after grading is fairly advanced, putting in piles for trestles and approaches only a short time before tracklaying, and after the structures are accessible. With a fully organized bridge department independent of grading contracts, and for a long extent of work, this method is often effective. Under other conditions, and in broken country, it frequently happens that the transfer of the driver from one structure to another would cost the contractor about as much as a new driver. In country where much rock or cemented gravel is found, piles cannot be driven as desired. It is also difficult to drive through rock fills, and these must be kept back if piling approaches are to be adhered to in all cases.

Where piles are to be used under the sills of frame trestles, frequently they cannot be driven more than four or five feet in cemented gravel; the small stones in this material are disturbed in driving, and it further disintegrates in time by slacking down. Hence the pile, with its small penetration, lacks lateral stability, especially when it projects several feet above ground, as is necessary in some piles of each bent in rough country.

Where a satisfactory foundation can be made on sub-sills on the ground,construction can be hastened. Ability and care are required on the contractor's part to place material around the end bents in a special manner, so as not to crowd them out of plumb. Such work should be done by extra bill, and stone be used if possible. The cost will be much less than in attempting to force the pile driver along a rugged piece of line. Some of the roads on which the writer has served have secured good foundations even in soft ground, by trenches filled with stone, with the weight distributed widely by ample subsill area. Large stones placed about the subsill give protection and leave ventilation sufficient to prevent rot. Trenches and ditches around the foundations, at some distance, insure drainage.

END BEARINGS.

The question whether the end bent should rest on mud sills in the bank or on solid piles or bents bearing in or on the original surface is much disputed. It is argued that the unsettled fill requires a flexible connection, like a ferry bridge. It is held that sudden rains will cause abrupt changes at a rigid end bent before repairs can be made. A finish of stone on the end of fill lessens the difficulty, or a rigid pile bent can be substituted for the mud sill bearing after the greater part of settlement has occurred. In either case the end of the fill should be run well towards the center of the first span, to avoid the always large settlement at the extreme end of the fill.

FOLLOWER PILES.

The problems, not only of construction in general, but of the special details, require care and preparation in advance.

Many advocate a long dowel, in some cases of wood. The dowel can,however,be only of such length as will ensure against lateral movement, without aiming at keeping the two piles in line by means of the dowel. Such an attempt, against the enormous leverages, the heavy blows, and the occasional powerful deflecting tendencies encountered, is useless,and the first object is too often not gained,owing to splitting. Care in driving is the only real safeguard against the latter.

Two rings, or one broad ring at the joint, are variously advocated, and some prefer none. The single ring, enclosing part of each pile, is used to keep the tip properly on the butt. It is probable that after a few blows it is found generally to be on only one of the two piles. With two rings, the object is to keep each pile from shattering, and this arrangement is probably best.

The tip of the upper pile should be as large as practicable. On account of the small tips (5 to 6 ins. diameter) on most of the spruce piling held in stock in the eastern States, to secure even 9 ins. diameter of follower wastes very much of the second pile. The contract should therefore name a price for waste tips, as well as waste butts, prepared for a follower.

CULVERT SUBSTITUTES FOR TRESTLES.

These are being much used, of hewed timber, all of the timber used being square; and several times as large as required for strength, generally 10 to 12 ins. square, some of the sides unhewn; thus giving ample allowance for rot in the floor, walls and roof. The waterway is arranged so that iron pipe inserted later, will give sufficient waterway area. The culvert waterway is made square, which is the most economical shape for this purpose. Increased waterway is obtained by two or more square openings.

D. R. K.

The Practice of Exact Railway Location with Taper Curves.

BY FRANK OLMSTED, LOCATING ENGINEER.

There is less attention paid to the science of locating a railway than to any other branch of civil engineering. In the main it is farther behind the general progress of the profession than seems accountable, when we consider how expensive mistakes are, either in the original construction, or in the after necessary outlay in operating.

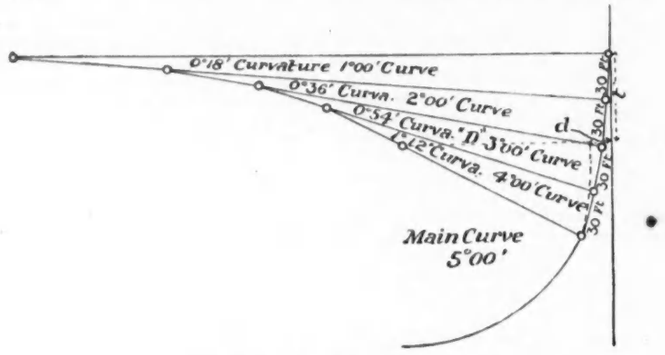
In a plain or prairie country, where rights of way, town site matters, and other ulterior questions determine the location, it is safe to delegate the selection of line to the attorney and an engineer who "picks up" location with a hand level and a "natural talent", but where a company wishes to build a line of railway for the legitimate purpose of railways, *i.e.*, the traffic, and desires to have as much tangent, as easy curves, as little grade, and as little expense as may be, in the nature of the country, then the importance of other matters than rights of way and rival town sites are apt to obtain, other qualifications than those of an attorney are needed, and more improved methods than backing up from an intersection point to the beginning of a guessed at curve are required.

There is not often any doubt as to the general course of a proposed railway. In a hilly or broken country the reconnoissances need not be very much in detail to settle the general alignment, the lowest summits, and the best approach to, and descent from them. The common mistakes are in not locally conforming the line to the ground, and this not with reference to two intersecting tangents, but to the whole possibility of the ground along the preliminary line. The method of calculated location is generally set aside as requiring too much time. Sixty-five miles of this location in Southern California, conditions about usual, occupied five months of last year.

Construction across this country by any other means of location would waste I believe $100,000, and the line could by no other method be so uniformly conditioned to handle the traffic for which it was designed.

The taper curve sheets here given were originated by WM. HOOD, Chief Engineer S. P. R. R. System, who first came into particular prominence some years since by the feat of personally locating one of the transcontinental lines from El Paso to Los Angeles, and whose methods of work are very superior.

In making a taper sheet a rail length has to be assumed for the reason that the taper stations conform to this rail length, and that, at least on curves with radii over 2,000 ft., the trackmen would find it impracticable to keep the taper from merging into a regular curve (this being the constant tendency of the passage of rolling stock)* were it not that the stations are defined by the rail lengths, and that their deflection is originally marked and may at any time be checked by the taper sheet. This tendency of the taper to work itself out regular is its worst feature, but it has so many positive advantages, and is so obviously an improvement on the ordinary circular curve that if it is once used or even thoroughly investigated its merits will be recognised.



Taper 2 and 5° 00′ Curve.

The main curve ought to be marked with 50 ft. station stakes: the radius being somewhat shorter than that ordinarily given in the field books. It can be found readily by dividing the radius of an ordinary curve twice the size by 2: thus the radius of usual 3°00′ curve is 1910.08 and of a 6°00 curve with 50 ft. chords 955.04. We will start with Taper 2 changing 1°00′ for every 30 ft.; that is, at the beginning of the taper the first 30 ft. deflects from tangent 0°09′ which is the deflection that 30 ft. calls for on a 1°00′ curve. The next 30 ft. is a 2°00′ curve and if the transit were moved up would be so deflected for, but this is not the case and the deflection is 0°22½′ from tangent: the next 30 ft. is 3°00′ curve and deflects 0°42′ and so on across the table to the deflection 4°45′ which estabiishes the beginning of the main 10°00′ curve. The chainmen now return to B. C., where transit still remains, and do up the tape which has been used to put in the 30 ft. taper station stakes and check over with chain the C. C. of main 10°00′ curve by one deflection from tangent 4°45′ and long chord distance which appears in the last column of Taper sheet. After moving up, the transitman turns to tangent by a back deflection of 8°45′ instead of the 4°45′ used to come ahead and runs in the main curve as usual. In the Taper, regular stations are disregarded and only reappear when main curve is reached. On placing the transit over the C. C. of the closing taper the instrument is first turned to tangent and the first 30 ft. deflects 1°21′, the next 2° 37½′, and so on, back across the table, until the 8° 45′ is reached, when chainmen return and as before establish end of taper or E. C. from long chord. When the transit is over E. C., tangent is fixed by turning off a back deflection of 4°45′. The sheets show the deflection required at whatever station the transit may be, or whatever the degree of main curve, up to 10°00′. No matter how often t is required to set up the transit to get in the taper, the long chord deflection and distance should always be used to carry the line ahead.

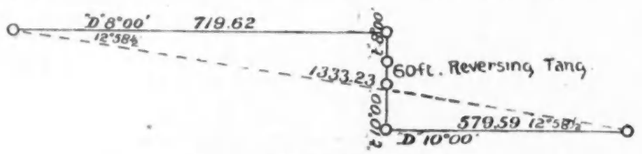
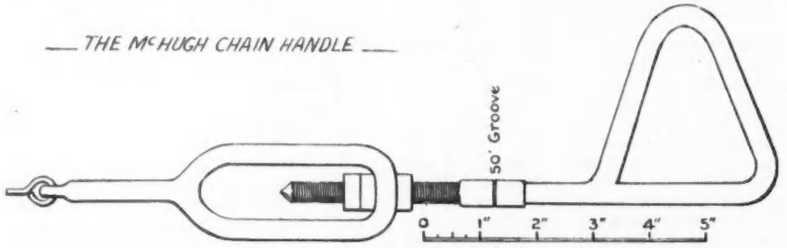


Diagram Showing Long Chord.

With Taper 1 the change is 0°30′ for every 30 ft. Taper 3 change is 2°30′ for every 30 ft. To find the distance from intersection point of tangents to beginning of curve, with tapers, multiply natural tangent of one-half intersection angle by "D" of diagram and add "t". "D" consists of the radius of the main curve plus small "d" or plus that distance which the taper has departed from tangent produced up to the point where "D," falling from center, makes right angle with tangent; "t" is the distance from this point on tangent to B. C.

A Traverse with tangent making north from B. C. around radii to center of main curve would give "t" from latitude and "D" from departure.

Example. Intersection angle 34°16′. Taper 2: main curve 5°00′; one-half angle=17°08′ natural tangent of which is .308277; times 1146.78=353.53; plus 60 ft. is 413.53, the semi-tangent or distance from intersection point to beginning of curve.



The McHugh Chain-Handle.

Before speaking of the method of calculating alignment notes I will refer to the appliances and checks which can alone render the work possible, and which are not extremely tedious and in no sense impracticable.

The outfit for field, office and camp consists of 18 to 22 men. The progress of the work depends largely upon engineering skill and executive ability of the locater and the rapidity and accuracy of the head chainman. Any assistant is easier replaced than head chainman. I use Christman's 50 ft. chain with one link taken off and the McHugh handle, shown by sketch herewith, attached; this latter allowing a daily adjustment from permanent hubs

* MR. OLMSTED is here quite wrong in his facts. So far from it being "the constant tendency of the trackmen to merge a taper or transition curve into a regular curve", the constant tendency and the constant practice is invariably the other way. No one ever saw a regular curve which was still regular in track five years old, unless special efforts were made to prevent the trackmen from following their otherwise universal and fortunate practice, to ease off the end of all curves by extending them back on the tangents and throwing them in at the P. C. and P. T. even at the expense of a sharp place in the curve beyond, which it is the object of the taper curve to avoid.—ED. ENG. NEWS.

TAPER 1.—CHANGING 30' 0' TO EACH 30 FT.

Transit at	Deflection to											
	B C 0° 30'		*C C* 1° 00'		*C C* 1° 30'		*C C* 2° 00'		*C C* 2° 30'		*C C* 3° 00'	
	°	'	°	'	°	'	°	'	°	'	°	'
B C 0° 30'	....	....	0	4½	0	11¼	0	21	0	33¾	0	49½
C C 1° 00'	0	4½	....	....	0	09	0	20¼	0	34½	0	51¾
C C 1° 30'	0	15¾	0	09	....	....	0	13½	0	29¼	0	48
C C 2° 00'	0	33	0	24¾	0	13½	....	....	0	18	0	38¼
C C 2° 30'	0	56¼	0	46½	0	33¾	0	18	....	....	0	22½
C C 3° 00'	1	25½	1	14½	1	00	0	42½	0	22½	....	....

Degree of Main Curve.	"D"	"t"	Total curvat'e each end of main curve.	"d"	Long Chord.	Length of each Taper.
1° 00'	5729.61	15.01	0° 09'	0.00	30.00	30.
1 30	3819.80	30.00	0 27	0.06	60.00	60.
2 00	2865.01	45.00	0 54	0.17	90.00	90.
2 30	2292.24	60.00	1 30	0.37	120.00	120.
3 00	1910.57	75.00	2 15	0.66	149. 99	150.

side notes where required, constitute the field work done personally by the engineer. In approaching a summit, the preliminary line (or lines, in case there is question which side of the valley to occupy or where crossings are probable) is run from valley elevation to summit before side notes are taken, and of course before location is commenced. The engineer then has the data before him with which to start the location.

TAPER 2.—CHANGING 1° 00' TO EACH 30 FT.

Transit at	Deflection to																	
	B C 1° 00'		*C C* 2° 00'		*C C* 3° 00'		*C C* 4° 00'		*C C* 5° 00'		*C C* 6° 00'		*C C* 7° 00'		*C C* 8° 00'		*C C* 9° 00'		*C C* 10° 00'	
	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'
B C 1° 00'	....	....	0	09	0	22½	0	42	1	07½	1	39	2	16½	3	00	3	49½	4	45
C C 2° 00'	0	09	....	....	0	18	0	40½	1	09	1	43½	2	24	3	10½	4	03	5	01½
C C 3° 00'	0	31½	0	18	....	....	0	27	0	58½	1	36	2	19½	3	09	4	04½	5	06
C C 4° 00'	1	06	0	49½	0	27	....	....	0	36	1	16½	2	03	2	55½	3	54	4	58½
C C 5° 00'	1	52½	1	33	1	07½	0	36	....	....	0	45	1	34½	2	30	3	31½	4	39
C C 6° 00'	2	51	2	28½	2	00	1	25½	0	45	....	....	0	54	1	52½	2	57	4	07½
C C 7° 00'	4	01½	3	36	3	04½	2	27	1	43½	0	54	....	....	1	03	2	10½	3	24
C C 8° 00'	5	24	4	55½	4	21	3	40½	2	54	2	01½	1	03	....	....	1	12	2	28½
C C 9° 00'	6	58½	6	27	5	49½	5	06	4	16½	3	21	2	19½	1	12	....	....	1	21
CC 10° 00'	8	45	8	10½	7	30	6	43	5	51	4	52½	3	48	2	37½	1	21	....	....

Degree of Main Curve.	"D"	"t"	Total curva. each end main curve.	"d"	Long. Chord.	Length of each Taper.
2	2864.87	15.01	0° 11	0.03	30.00	30.
3	1910.06	30.01	0 54	0.14	60.00	60.
4	1432.85	45.01	1 48	0.38	90.00	90.
5	1146.78	60.00	3 00	0.77	119.99	120.
6	956.40	74.99	4 30	1.36	149.96	150.
7	820.82	89.95	6 18	2.18	179.91	180.
8	719.62	104.90	8 24	3.28	209.81	210.
9	641.47	119.80	10 48	4.69	239.63	240.
10	579.59	134.66	13 30	6.45	269.35	270.

Continually, during the progress of the work, questions arise which are not settled by the preliminary notes, and which demand additional side notes. There are often times when the locator, with office assistant to check calculations, will have considerable night work to keep the line laid out ahead for the transitman, but with experience there will be no delay, and time put in at night can be caught up in the day.

All the tapers, including a foot of tangent and a foot of main curve, should be drawn on a scale of 50 ft. to the inch, and traced on vellum cloth so that

TAPER 3.—CHANGING 2° 30' TO EACH 30 FT.

Transit at	Deflection to																	
	B C 2° 30'		*C C* 5° 00'		*C C* 7° 30'		*C C* 10° 00'		*C C* 12° 30'		*C C* 15° 00'		*C C* 17° 30'		*C C* 20° 00'			
	°	'	°	'	°	'	°	'	°	'	°	'	°	'	°	'		
B C 2° 30'	....	....	0	22½	0	56¼	1	45	2	48¾	4	07½	5	41	7	29½		
C C 5° 00'	0	22½	....	....	0	45	1	41¼	2	52½	4	18¾	6	00	7	56		
C C 7° 30'	1	18¾	0	45	....	....	1	07½	2	26¼	4	00	5	48¾	7	52½		
C C 10° 00'	2	45	2	03¾	1	07½	....	....	1	30	3	11¼	5	07½	7	18¾		
C C 12° 30'	4	41¼	3	52½	2	48¾	1	30	....	....	1	52½	3	56¼	6	15		
C C 15° 00'	7	07½	6	11¼	5	00	3	33¾	1	52½	....	....	2	15	4	41¼		
C C 17° 30'	10	04	9	00	7	41¼	6	07½	4	18¾	2	15	....	....	2	37½		
C C 20° 00'	13	30½	12	19	10	52½	9	11¼	7	15	5	03¾	2	37½	....	....		

Degree of Main Curve.	"D"	"t"	T'l cu've in each end of ma'n cur	"d"	Long Ch'd.	Le'th of each taper
°	'			°	'		
5	00	1146.11	15.00	0	45	0.10	30.00	30.
7	30	764.48	29.99	2	15	0.40	60.00	60.
10	00	574.12	44.97	4	30	0.99	89.98	90.
12	30	460.56	59.93	7	30	1.97	119.92	120.
15	00	385.68	74.82	11	15	3.43	149.76	150.
17	30	333.20	89.62	15	45	5.48	179.43	180.
20	00	295.04	104.27	21	00	8.20	208.80	210.

they can be laid over the preliminary line, and their course considered with reference to the surface of the ground.

The calculated location can not generally be made more than for the day's run. The discrepancy in angle or distance shown by the night's chain-check, however small it may be, is enough to swing the line off ahead, so perhaps it will not hang on a bench without slipping over, or at least vary enough to make a constantly diverging location from the one designed. In case the line is calculated ahead and the field work fails to check, as in the connection of the last two problems, the distance out (in this case 5 ft.,) is divided by the sine of total curvature in succeeding curve, and by backing up or going ahead with the *B. C.* this amount. In the case given, the *B. C.* of 10° 00' right should be "E" 854 + 32' if the correction were made and the station numbers of the problems were connected.

The location line is designated as "E" and the preliminary as "L", for abbreviation.

in camp, established with steel tape at proper temperature. The head chainman has a pocket level and both have plumb bobs, and there is seldom a measurement which does not require a momentary use of both. Hard pulling is required, but with good men, no matter what the ground, they will check out with a maximum discrepancy of .06 ft. per mile. Small hickory skewer pins 6 ins. long, obtained at the butcher's, are carried by the head chainman to mark the distance, and collected by the stake artist when the permanent line stakes are driven. A good head chainman will make the very slight allowance required by changes in temperature when sticking these skewers, which are sloped to one side of line so the bob can plumb over them. All 50 ft. measurements are made with chain, all fractional ones with tape, and transit points are of course double centered. The original preliminary line is platted in the office on duplex paper 50 ft. to the inch, by latitude and departure.

Flagging the preliminary line through, taking superficial material notes, and making up accurate

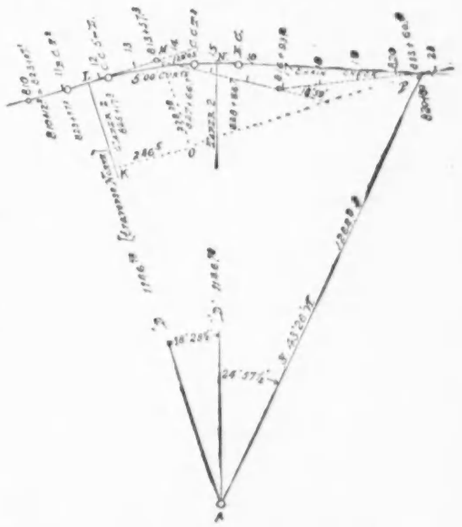
PROBLEM NO. 1.

In this case the angle preliminary line is shown from Station 810 to Station 821, with the included angles.

The final location is assumed to have reached a point 12.3 ft. ahead of Station 810, "preliminary" where it intersects, bearing 0° 09½' to the right.

[We disapprove entirely of the use of fractionations of feet in the stationing and fractions of minutes (except occasionally ½) in the angular work. It does not in the least conduce to the real accuracy and excellence of the work, while it does unnecessarily complicate matters. The practice, in our judgment, arises only from confusion of the broad distinction between *precision* and *correctness*. However, we leave the notes and examples as sent to us.—ED.]

We will assume from the paper location trial line that a 5° curve, Taper 2, whose resultant tangent shall pass 42 ft. to the left of Station 818, "preliminary" to an intersection at Station "L" 820 + 80, is the closest approach to the theoretical location the ground admits of. To find the proper alignment notes: From the drawings we will have to assume a temporary *B. C.* at Station 824, "E" line.



Railway Location with Taper Curves. Problem 1.

Starting a traverse at the center end of "D", calling its course north, thence 90° 00' left, the "t" distance 60 ft. + the distance from *B. C.* back to intersection with "preliminary" 92.9, thence following the preliminary to Station 818, thence 90° left the 42 ft. The next bearing and distance is found by reducing the right angle triangle, whose perpendicular is 42 and whose base is the distance from

Center End.	Distance.	Angle.	Bear.	North.	South.	East.	West.
"D"	1146.78		North.	1146.78	.....	.....	
On tangent.	152.90	90° 00' *L.*	West.	.....	.....	.....	151.90
810 + 12.3	345.00	179° 50½' *R.*	N. 89° 50½' E.	0.96	.....	345.00	
813 + 57.3	355.90	29° 05' *R.*	S. 61° 04½' E.	.....	162.46	294.00	
816 + 93.2	106.80	18° 59' *L.*	S. 80° 03½' E.	.....	18.44	105.20	
818	42.00	90° 00' *L.*	N. 9° 56½' E.	41.37	.....	7.25	
	283.10	98° 32' *R.*	S. 71° 31½' E.	.....	89.71	268.51	
				1189.11	270.61	1019.96	151.90
				Northing, 918.50		Easting, 868.06.	

Station 818 to 820 + 80 ft. The whole traverse being as above.

We have the nominal bearing of both tangents in this traverse, which gives us the actual amount of curvature to be developed, viz., 18° 28½'. The semi-tangent for which is 246.5.

In the traverse we have seen that the total northing is 918.5, this is definite and independent of the movement east or west that "D" may make on the tangent; "D" being 1146.78. The distance from B. to C. must be 228.28. To determine, now, how near right our assumption of Station 824 for beginning of curve was, we have the semi tangent of 246.5 of known easting, and from the plan the triangle

o. m. p., whose perpendicular is 228.28, and acute angle is 18° 28½′, giving a base of 683.2. These added give 929.7, or required easting. By comparing this with the Traverse we find it 62.83 more. Taking into account the 60 ft. of "t" we shall have to back up our *B. C.* 2.83 ft., or to Station 823 + 97.2. Each Taper 2 of 5°00 curve has 3°00 curvature and 120 ft. distance; so out of the 18° 28½′ only 12° 28½′ remains for the main curve, or 249.5 ft. Before making up the alignment notes from these curve quantities we will reduce the corrected traverse for a chain check.

Northing of 918.5 and easting of 869.7 gives closing course of S. 43° 26′ W. 1264.9.

Inside of this triangle we drop another "D" from center to form a right angle with the "resultant tangent". We then have the base and hypothenus, dividing the first by the latter and taking the angle from cosine, we have the interior angle of 24° 57½′, and perpendicular of 533.7; 60 ft. of this latter belong to the curve as "t" the balance 4737 is the distance from end of curve to intersection with preliminary.

TRANSIT NOTES.

"E" LOCATION. MAY 20, 1888.

Intersection Angle 8° 32′ Left.

833 + 60.4 = "L" 820 + 80.

828 + 86.7 *E. C.*

3° 00′

827 + 66.7 *C. C.*

12° 28½′

825 + 17.2 *C. C.*

3° 00′

823 + 97.2 *B. C.* T. 2.

Intersection angle 0° 09½′ right.

Semi-Tang, 246.5.

E. 823 + 68′ = Preliminary "L" 810 + 12.3.

(TO BE CONTINUED).

Exhaust Muffler used on Locomotives on the Pennsylvania Railroad.

The exhaust muffler, illustrations of which we give herewith, is used quite extensively on the Pennsylvania Railroad at terminals where trains start from under cover, as at Philadelphia and Jersey City, where the noise made by the escaping exhaust steam is very disagreeable.

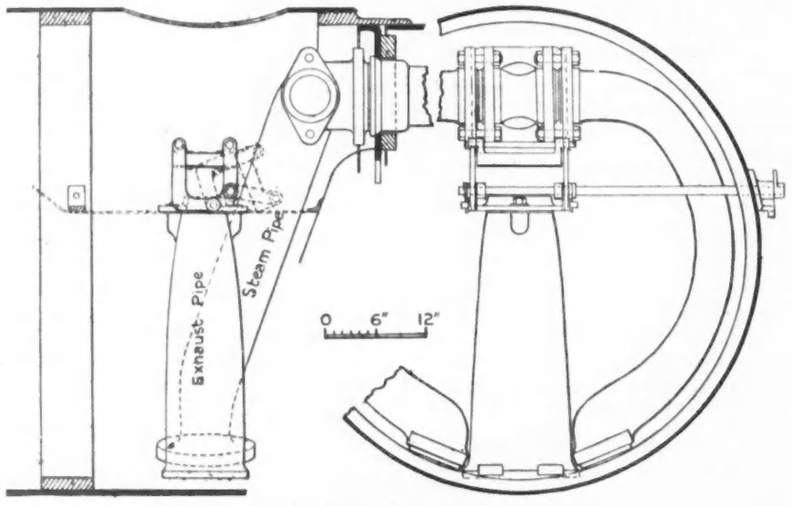


Fig. 1. Front and Side View of Muffler in Position.

As is apparent from the illustrations, the steam jet escaping from the cylinders is broken up by placing a wire screen above the openings of the exhaust nozzles. Fig. 1 shows the exhaust nozzles with the muffler attached, the full lines indicating its position when in use, and the dotted lines showing it when not in service.

The frames are hinged in such a manner to the tops of the exhaust nozzle that by turning a lever outside of the smoke box to an angle slightly over 90 degrees, the muffler may be entirely removed from above this opening and so placed as to neither obstruct the escaping steam, nor, to any great extent, the gas passing through the wire netting of the spark arrester. A simple catch is provided on the lever so as to keep it in either of the two positions.

Fig. 2 shows the muffler plate, which is of cast-iron, and to which the wire screen is riveted. Fig. 3 shows the cap for the exhaust nozzles, to which the muffler plate is attached as shown in Fig. 1.

Syphons of the Kansas City Water Works.

In a paper presented at the Annual Convention of the American Society of Civil Engineers, held recently at Milwaukee, by Mr. G. W. PEARSONS, some details were given concerning these syphons, in addition to what appeared in the very full account of the Kansas City Water Works published in this journal beginning with Nov. 5, and concluded Dec. 24, 1887. A very full abstract of the paper is herewith given.

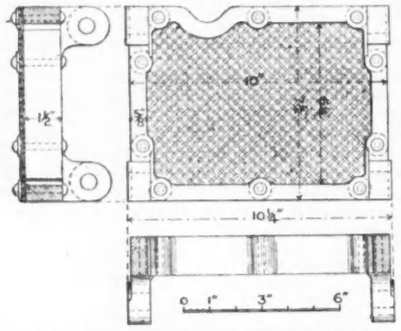


Fig. 2. Muffler Plate With Screen Attached.

The nearest available location where drainage could be had for the settling basins was a quarter of a mile from the river and the conditions such that a syphon was the only available means of reaching the pumping station. The soil, a sandy alluvium, surface 28 ft. above low water, about half of the depth can be excavated readily; the lower part, when dug into, shows decided characteristics of quicksand making a deep trench both difficult and dangerous. A trench low enough to insure adequate flow at low water was impracticable; a syphon to be safe, must be tight, and to insure this, it must be reasonably accessible.

The trench was dug 13 ft. deep at the pumping station, 15 ft. near the river, descending by an easy vertical curve; the pipe, 24-in. cast-iron, with ordinary lead joints, was laid with care as to grade so that no air pockets should exist, rising all the way to the well where it joins a vertical pipe by a T, with well rounded angles, the top of this vertical pipe rises 6 ft. above the syphon, forming a vacuum chamber; the bottom reaches within 18 ins. of the bottom of the well, which is 7 ft. below low water in the river, giving an available slope of 5 ft. at extreme low water. There are no bends in the line except such easy curves as could be laid with straight pipe; its delivery is 10,000,000 galls. in 24 hours, with a frictional resistance of 22 ft. per mile or 4.11 ft. per thousand.

During high water, the sypnon being practically submerged, acts as a conduit and is controlled by a valve at the pumping station. It was carefully tested as to tightness before filling the trench, but it was found necessary to maintain the vacuum by an air pump attached to one of the engines; this was 3-in. bore, 12-in. stroke, making 18 to 24 strokes per minute, sufficient at first, but within a year it became necessary to aid it by a pipe to one of the condensers; after some five or six years run the air leakage made a reduction in the vacuum in the condenser. The pipe was uncovered and the joints recaulked, when it recovered its original tightness. A larger air pump was also put in. In the 12 years of its run, the syphon has never failed, and the only expense attending its use, aside from the working of the air pump, which, being attached to the machinery makes no appreciable labor or cost of maintenance, is the recaulking of the joints, which was expensive on account of the depth of digging required to reach them.

At Quindaro, the new pumping station on the Missouri, it again became desirable to go away from the river for safety. There the syphon is 730 ft. long, with a rise of 10 ft. in the middle. The pipe is 42 ins. in diameter, cast-iron with lead joints. The bottom of pipe trench was so soft that it had to be planked to preserve the alignment of the pipe. A steam ejector is used to maintain the vacuum; at present the pipe is so tight that it requires but a few minutes use daily, a vacuum gauge being placed in the engine room for the engineers guidance. The pumping engines at this station have a capacity of 1,000,000 galls. per hour, not enough to test this syphon to anything like its full capacity, which is probably over 50,000,000 galls. per day—having an available slope of 12 ft. per thousand.

The use of the first syphon showed that while absolutely air tight, there was still a sensible amount of air constantly removed by the air pump, showing that it was dissociated from the water. The writer had no means of making quantitative tests, but from observation saw that the amount of air varied sensibly in accordance with the amount of water flowing through the pipe, and that with the full lift of 16 ft. the dissociation was much greater than with smaller lifts—seemingly greater than the difference.

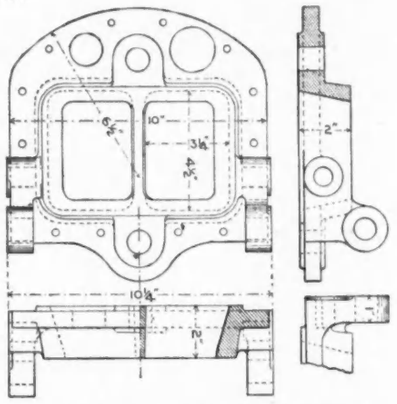


Fig. 3. Cap for Exhaust Nozzles.

The use of these syphons shows that they can be safely depended on in places where it is difficult to lay conduits low enough for direct gravity flow, and that the receiving well which they require is an additional safe-guard in avoiding pulsations or shocks which would tend to to produce air leaks in the joints, and insures the pumps against unequal or undesirable admission of air as well as against the water ram incident to a long suction pipe.

As an example of the rapid progress made in marine engineering in the last few years the latest English cruiser *Magicienne* is cited:

While the early ironclads had little more than 0.6 indicated horse power per ton of displacement the *Magicienne* has 9000 indicated horse power on 3000 tons displacement. Its total grate area is 456 ft., or about 1 sq. ft. of grate to 20 indicated horse powers. This approaches the proportions in locomotive practice, as a bituminous coal-burning engine will develop 300 to 400 indicated horse power from 20 sq. ft. of grate. Fifty years ago marine engines weighed about 1500 lbs. per indicated horse power, but in the latest examples the weight has been reduced to 82 lbs. per indicated horse power.

REMOVAL. — The Chalmers-Spence Company of New York, whose Asbestos specialties, more particularly their removal of fire and water proof pipe and boiler coverings, are well known throughout the United States, removed their Philadelphia office on July 16th from 32-34 South 2d St., to 24 Strawberry St., where their representative will be pleased to show their wares, and explain their merits to all interested parties.

JUST after the terrific rainstorm of July 19, a bridge on the Baltimore & Ohio R. R., spanning the Wheeling creek, in Wheeling, W. Va., gave way and precipitated several persons who were standing on the bridge into the stream. The first reports estimate the loss of life at 20 persons.

Dump Cars; Canadian Pacific Railway.

The dump cars here illustrated are from sketches furnished us by Mr. THOMAS KENNARD THOMPSON, of the Dominion Bridge Co., and show the types used in the construction of the Canadian Pacific Railway.

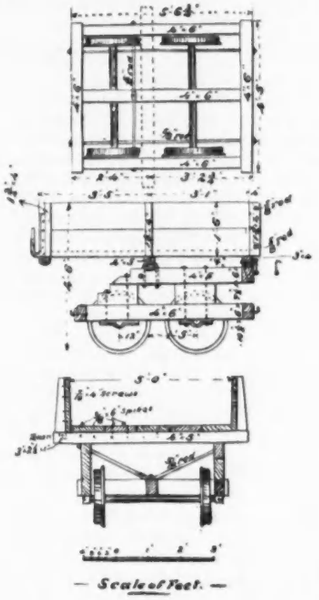


Fig. 1. End Dump Cars. C. P. Ry.

There were two distinct kinds of dump cars used in the Rocky Mt. divisions. The first type is shown in Figs. 1 and 2, and were designed by Mr. DOANE they were exceedingly well adapted to dumping earth and were preferred for this service.

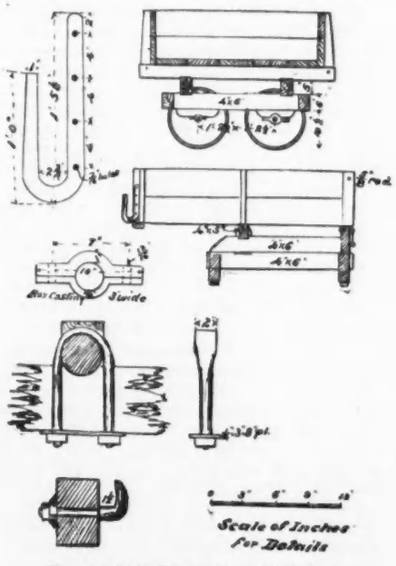


Fig. 2. Side Dump Cars. C. P. Ry.

The second type, Figs. 3 and 4, were brought by Mr. GARDNER from the Northern Pacific Railroad and were used in the heavy rock cuts. It is believed that the views and dimensions given will be sufficient for a proper understanding of the style and build of these cars.

IT is announced that the New York Central Company has secured control of the Poughkeepsie bridge, a wholly unlooked for development in connection with that new artery of traffic. The deals and vicissitudes which the enterprise has gone through have been rather intricate, but if the Vanderbilt interests have taken it into their hands, it will be likely to stay there for some time to come.

Twin Locomotives for India.

Messrs. Neilson and Co., Hydepark Locomotive Works, Glasgow, have completed a pair of twin locomotive engines and tender for the Indian State Railways (North-Western line). They are the first of the kind which Messrs. Neilson have constructed, and constitute part of an order for 20 engines and 10 tenders which the firm lately received from the Indian Government. The engines have outside cylinders with three pairs of coupled wheels placed

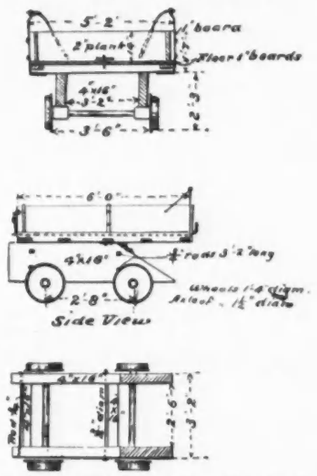


Fig. 3. End Dump Cars. No. Pac. R. R.

between the cylinders and the firebox. This allows the rigid wheel base to be the shortest possible. Between each two engines is placed a six-wheel double-ended tender, containing the fuel and water required by the two engines. Each engine is fitted with a powerful steam brake, which acts upon all the wheels, while the tender is furnished with a hand brake, which can be put in operation from either end.

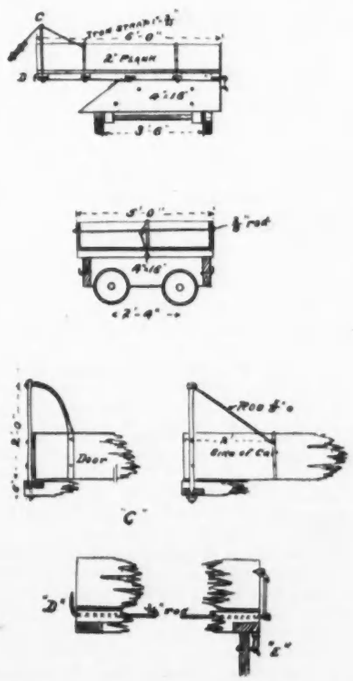


Fig. 4. Side Dump Cars. No. Pac. R. R.

The leading dimensions of these engines and tenders are as follows: Diameter of cylinder, 19 ins.; stroke, 26 ins.; diameter of wheels, 4 ft. 2 ins.; diameter of tender wheels, 3 ft. 7 ins.; wheel base of each engine, 9 ft. 6 ins.; wheel base of each tender, 9 ft. 6 ins.; total wheel base of two engines and tender, 57 ft. 9 ins.; total length over buffers, 80 ft.; contents of tender, 3,000 galls. of water and 8 tons of coal; weight of each engine loaded, 97,552 lbs., weight of tender loaded, 91,616 lbs.; total weight of combination, consisting of two engines and tender in working order, 128 tons. The engines are beautifully finished. They are to be employed in working the traffic on the heavy inclines on the Scinde Pishin Railway, through the Bolan Pass. Messrs. NEILSON also have just completed and despatched five exceptionally heavy broad-gauge tank locomotives for the Khojah extension railway on the Afghan frontier.

These engines, which each weigh 70 tons in working order, are guarenteed by Messrs. NEILSON to take trains weighing 70 tons, exclusive of the weight of the engine, up an incline two miles long with a gradient of 1 in 15, and to go round curves of 500 ft. radius. Messrs. NEILSON designed, constructed, and delivered these engines in the very short time of fourteen weeks from the date upon which they received the order.—*Engineering.*

A CORRESPONDENT writes us for "some information concerning the literature of graphical statics, and how widely the knowledge of this method is disseminated among engineers and architects." This method is almost universally applied in designing roofs, bridges and other stationary structures, for finding the stresses in the various members. The subject is taught in all technical schools, and nearly every work on bridges contains an explanation of the method, and examples in which it is practically applied. Its application in mechanical engineering has not been so general, but it is used to some extent for determining the moments to which machine parts are subjected. As to treatises on this subject, limited space permits only the mention of a few well known authors. The works of CHAS. E. GREEN, *Bridge Trusses, Arches,* and *Roof Trusses,* are widely and favorably known, as are also those of A. J. DUBOIS, HENRY F. EDDY, RICKER, and a multitude of others. *Some Applications of Graphical Statics* is the title of a paper recently read before the Am. Institute of Architects, by JAMES R. WILLETT. On the application of this method to mechanical engineering a very excellent work is SMITH'S translation of HERRMAN'S Graphical Statics of Mechanism.

A DRAUGHTSMAN correspondent of *The Engineer* loudly complains of the condition of the craft in England, alleging that after paying £35 apprentice premium and serving his time he is generally offered "the munificent sum of £1 per week," and mentioning several instances where draughtsmen in responsible positions receive 22 to 25 s. per week. *The Engineer* makes the trenchant comment:

"We publish our correspondent's letter, although we believe it will do no good. Low salaries are a result of the fact that there are too many draughtsmen. In a recent instance which came under our knowledge, 320 applied for a situation worth 30s. a week. Very many of the applicants were Germans. It appears that technical education of a very high order in Germany makes a man, as a rule, worth about £1 a week. No possible combination of English draughtsmen can raise the rate of pay in the face of the fact that any number of Germans can be had for the asking."

THE extension of the Suburban Rapid Transit Railway in the northern part of New York City is being rapidly pushed, and the terminus is now near 170th Street. The superstructure is being put up at the rate of about 200 ft. per day.

Fast Trains on The London & Northwestern Railway.

The startling announcement was made recently that the London & Northwestern Ry. Co. was about to run trains from London to Edinburgh and Glasgow in an hour less time than hitherto, and this without interference with the dinner interval at Preston. The company appears to have made up its mind that the London & Northwestern, although it has no long standing traditions of "flying express" running, can walk into the field and hold its own against all comers. The journey from London to Edinburgh is 400 miles, and the Euston managers have determined that it shall for the future be accomplished in 9 hours, or, deducting the 25 minutes for dinner at Preston, and the 3, 5, 7, 7 and 3 minutes for stops at Willesden, Rugby, Crewe, Carlisle and outside Carstairs (the latter for joining or detaching the Glasgow half), in 8 hours 10 minutes. This splendid run was first successfully accomplished on

June 1, the up train, drawn from Scotland by three engines only—Edinburgh to Carlisle, Carlisle to Crewe, and Crewe to Euston—arriving at the later station a minute and a half before its time, notwithstanding a check at Nuneaton.

To Approximate Curves by Circles.

In the *Centralblatt der Bauverwaltung* Mr. F. ADAMS gives a simple method for facilitating the drawing of curves by approximate circles.

If we draw the chords *AB, BC, CD,* . . . . in a compound curve *AE*, and then draw in a circle of assumed radius, chords parallel to the above, *ab, bc, cd* . . . . and the respective radii *bm, cm, dm* . . . .; we will observe from the similarity of the triangles *ABM* and *abm*, *BCM* and *bcm* . . . ., that the radii thus drawn will indicate the direction of the normals to the curve at the points *B, C, D* . . . . The only condition being that the direction of the first and last radii of the circle is assumed as parallel to the corresponding normals of the given curve.

The accompaning diagram shows the application in the case of an ellipse.

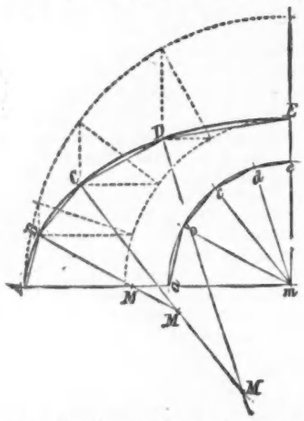


Diagram for Drawing an Ellipse Approximately.

CORRESPONDENCE.

The "Air Ship" Project.

CORNWALL, Ont., July 10, 1888.

EDITOR ENGINEERING NEWS:

Seeing your comments in a late number on the air ship to be built by Dr. DE BAUSSET, the thought struck me, "of what thickness of steel can a large cylinder be made and yet be able to float in the air when its inside air is exhausted?" A couple of rough calculations of different sized cylinders looks anything but favorable to the success of DE BAUSSET. A cylinder 300x100 ft., can only be made of steel $\frac{1}{32}$ inch or less in thickness to carry its own weight, and this without allowing anything for laps or interior bracing, of which latter I should imagine there would have to be considerable to withstand the pressure. It looks therefore to me as if the inventor will not be troubled much with the navigation of his "ship." W.

Heavy Rain Falls.

University of Illinois.
CHAMPAIGN, Ill., July 9, 1888.

EDITOR ENGINEERING NEWS:

In connection with the mention on page 1 of large rainfalls the following may be interesting. On July 8 we had a rainfall of 1.20 ins. in 15 minutes, and 8.10 ins. in 22 hours. The water was caught in a U. S. Weather Bureau standard gauge, and with a fair exposure. There seems to be good reason for believing that this is the heaviest rainfall ever known here.

IRA O. BAKER.

Earthwork Computation.

JULY 2, 1888.

EDITOR ENGINEERING NEWS:

Will you or some of your readers kindly give me the area of the triangle *A B C* and also the method of computation? Yours truly, E. REED.

[To compute the area of a triangle correctly, it is not necessary to have the actual base and actual height. We may take the length of the base as projected on to any line and determine the altitude at right angles thereto,

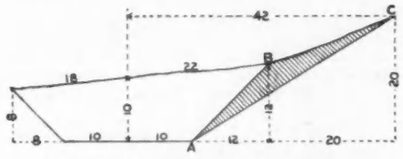


Diagram for Earthwork Computation.

an often convenient fact which results from elementary geometric, principles but is not always remembered. In this case we have *Base* (horizontal) 32 ft. *Height* (vertical) $12-(20\times\frac{11}{20})=12-7.5=4.5$ ft. *Area*, $\frac{32\times 4.5}{2}=72$ sq. ft.

We presume the purpose of our correspondent had reference to this fact (otherwise we should not have published the letter) since the computation is perfectly simple thus:

$$\frac{32\times 12+20\times 20-32\times 20}{2}=72$$

It is practically better to plot all such cross-sections.—ED. ENG. NEWS].

Formulæ for the Profile of Engineering Dams.

Engineering Department, Canadian Pacific Ry
MONTREAL, July 10, 1888.

EDITOR ENGINEERING NEWS:

I have been a good deal interested in Mr. WEGMANN's formulæ for calculating the profile of masonry dams, as published in your issues of February 4th and 11th of this year.

I have verified all the formulæ given, and have arrived at the same results as those published except in the case of equations (*b*) and (*g*).

The difference is due, in each equation, to a slight misprint I think. I find the first term in the right hand part of equation (*b*) to be $\frac{3\,W^1\times d}{h}$ and not $\frac{3\,W\,d}{h}$ here I think I must be correct as *W* involves a knowledge of "*l*" which is the unknown quantity.

In equation (*g*) I find the last term of the right hand side to be $l^2\left(h-\frac{p^1}{2}\right)$ not $l^2\left(h\frac{p^1}{2}\right)$. From the analogy between equations (*g*) and (*l*), I think I am correct in this case also. Would you kindly put me straight? Your obedient servant,

H. IRWIN.

[The better person to put our correspondent straight is Mr. WEGMANN himself, to whom we leave the question—ED. ENG. NEWS.]

The Metric System.

BOSTON, July 18, 1888.

EDITOR ENGINEERING NEWS:

The editorial on the Metric System, which appeared in your number of July 7, explained admirably the many advantages to be obtained by its general adoption in the United States, and is important as being calculated to call the attention of our people to a reform which for a good many years has been slumbering and attracting but little notice.

It was as long ago as 1866 that, thanks principally to the efforts of Hon. JOHN A. KASSON, at that time a member of Congress from Iowa, the Metric system of weights and measures was made by act of Congress *legal* in the United States, as it remains today. But this is not enough, and it will never be adopted until it is also made *obligatory*. It is certainly astonishing that a people as progressive as we are should prefer to adhere to the old and cumbersome systems now in use, instead of accepting the Metric system, which can be learned by anyone in ten minutes, and then cannot be unlearned or forgotten. There is no branch of human activity, scientific or practical, in which it is not the best thus far offered to the world.

The American Metrological Society, of which President BARNARD of Columbia College is the head, still exists and does some work in its behalf, but not in a way to reach many persons. The American Metric Bureau, which had its headquarters in Boston, did a great deal for several years, beginning in 1876 or '77, but it no longer is in the field of usefulness. Its President was also Mr. BARNARD, and its most active worker, Mr. MELVIL DEWEY, now librarian of Columbia College, with many others who contributed in various ways to carry out its objects. These were to furnish instruction in the metric system by charts and text books, to see that they were introduced into schools, and also to sell metric instruments of many kinds at almost cost prices, for which there was a special branch of the bureau. Prof. HILGARD, at that time in the service of the U. S. Coast Survey, was a valuable aid, as it was through him that metric standards were made, which were to be furnished to the treasurer of any State that might ask for them. Prof. E. B. ELLIOTT, of the U. S. Treasury Department, did a great deal, as he was wonderfully proficient in all calculations by which the coinage of gold and silver could easily be made exactly metric, and in a way that would very little disturb it as then existing. The writer of this has before him a bill presented by Hon. A. H. STEPHENS of Georgia, Chairman of the House Committee on Weights, Measures and Coinage, which was prepared by him with the assistance of Messrs. ELLIOTT and BARNARD, as long ago as 1877, and which in many of its features was taken from a previous one prepared by HON. WM. D. KELLY, of Pennsylvania.

When the United States became one of the parties of the International Postal Union, we, like other nations, accepted 15 grams as the weight for single postage, and, to accomplish this, a bill was passed making "15 grams the equivalent for postal purposes of one-half ounce avoirdupois, and so on in progression". This was also made legal for domestic postage, the half ounce then being the limit for single rates, and the postmaster-general was instructed to furnish metric balances to cities exchanging mails with foreign countries. This was clearly to our advantage for domestic purposes, as 15 grams is a little more than half an ounce.

In the American hemisphere the metric system is, I believe, universally used everywhere south of the Rio Grande, from Mexico to Cape Horn, and this may be said of the rest of the globe generally, with the exception of England and her colonial possessions. From this it can be seen that all merchandise we receive from other countries (except England and her possessions) is invoiced in metric measurements or weight, and has to be changed, at considerable time and trouble, by our custom house officials, from meters and kilograms into feet and pounds. Then, too, in sending our products into countries which use the metric system, we are at another disadvantage in selling them, for importers and customers have to reverse the operation, whereas, if sent in metric figures, they are saved this bother, and so accept them more readily.

To show how easily the metric system can be introduced into a country by making it obligatory, you have only to cite the case of Germany. A good many improvements were inaugurated in the growing empire shortly after the war with France, and among them was the adoption of metric values for weights and measures. The law was passed by which at a certain date, Jan. 1, 1876, if my memory serves me correctly, it was to be obligatory all through the land, a bargain made by the old system would not be binding after that date, and a long time was given the people to study it before it was to come into practice, several years, I think. Happening to be in Germany shortly before the required date I noticed in many of the shop windows metric charts displayed, large enough to be read and made out by any passer-by, with the weights and measures for solids and liquids represented in their exact size, and so it can be seen that the populace had no difficulty in mastering the subject, should they put off their studies until only the day before it was to be obligatory. All the rising generation of German immigrants to our shores, as well as those of other continental countries, come here with a full knowledge of the metric system, and it is indeed a pity that, as soon as they land, they should have to discard it, and take up an antiquated and complicated method of reckoning weights and measures

There can be no doubt but that the metric system is the best and simplest for all the calculations that come in the routine of every day life. Add to this the precision and accuracy required in scientific investigations and practice, and foremost among them *engineering*, which can best be secured by this system, and there is every reason for urging our people to adopt it as soon as possible.

NATHAN APPLETON.

Preparation for Electrical Engineering.

BUENA VISTA, Ga., June 30, 1888.

EDITOR ENGINEERING NEWS:

I have a brother, 18 years old, who has fitted himself to enter college. He wishes to study electrical engineering. What I wish to know is: how had he best proceed; go to some technological school or learn it elsewhere? If the former, which, in your opinion, is the best school to go to?

If you will give me the benefit of your advice in the matter I will be very much indebted. I am entirely ignorant of the methods followed in training for this profession. Yours truly, C. M. C.

[Without a doubt the best way to become an electrical engineer or any other kind of engineer is to take a regular technical course, thus laying a substantial foundation on which to build a superstructure of more extended knowledge. There are good engineers who have never had this training, and it has only lately become attainable in electrical engineering, but it is generally acknowledged that the lack of it is constantly felt to be a drawback, and keeps many men from attaining the higher positions which its possession might have made possible.

To attempt to specify the best of our technical schools for this, or any course of study, is a rather delicate matter for an engineering journal to deal with. Most of the technical schools have made special provisions for work in this department; and in some of them, notably Cornell, Lehigh, Boston Inst. of Technology and Stevens, a regular course in electrical engineering has been established, which is just as independent as are the courses in civil and mechanical engineering, and on the completion of which a degree is conferred. We are pleased that we can honestly say that we do not know which of these colleges now gives the best preparation for electrical engineering. The course at Lehigh University, South Bethlehem, Pa., is a very good one. It requires four years for its completion, throughout which a large part of the time is devoted to electrical work, either theoretical or practical. The laboratory is well equipped with dynamo, apparatus for electrical measurements, etc. In addition to this the student gets all the mathematics ordinarily given to technical students, instruction in machine design and other studies belonging specially to mechanical engineering, but which are equally necessary to the electrical engineer, and an extended course in chemistry, including work in qualitative and quantitative analysis. Visits of inspection to electric plants and exhibitions which may be in progress form a part of the regular work, and in the more advanced stages of the course the student is encouraged to carry out some original investigation. The other subjects incidental to the course relating to general education and training, need not be enumerated. The courses in the other colleges named, and no doubt others, cover substantially the same ground.—ED. ENG. NEWS.]

A Lady's View of the Milwaukee Convention.

EDITOR ENGINEERING NEWS:

Whether you will care at all for a feminine view of the late Convention, I very much doubt; but minister's larks and professional men's outings had always been held up to me as proverbially pleasant affairs, so when I had an opportunity to join one of the latter, I seized it with avidity, expecting the full quota of pleasure as well as profit.

A sweltering June day, the Grand Central Depot, a special train of Wagner cars, a group of expectant faces of all ages, and we were off. At the Delavan House at Albany we found awaiting us a telegram from Milwaukee that the thermometer had gone down to 45 degrees, and that toboggan suits and snow shoes were in order.

Just beyond Rochester we were delayed, we knew not why until we learned that there was a wrecked freight train ahead and, switching off on another track, we passed it, car piled on car, "telescoped" one into another, a confused and intricate mass. It was dark now, and up near where the engine had been, lanterns flashed and moved about where a silent group of men were working with axe and pick, their determined faces and powerful limbs standing out in the glare of the headlight. A brakeman of the wrecked freight lay there, dead now, but living for 30 horrible minutes after the accident. One of life's myriad tragedies had thrust its grim face upon our pleasure journey. That night the throbbing of the engine as it plunged on in the darkness was, to me, the labored breathing of a veritable monster and the slow, constant ringing of the bell, a toll.

A run through Canada by night, and here we made what they told us was the fastest time on record; between St. James and Windsor, a distance of 112 miles in 109¼ minutes; these figures are accurate, reliable and trustworthy, that is to say, they are the timing of the trainmen; the civil engineers were asleep. Ours was a train of four cars, and Mr. JAY GOULD, with a train of two cars, on an inspecting tour, had made the same run in 111 minutes; so, you see.

We took on our dining car at Jackson, Mich., and if it was not well patronized by an appreciatively hungry party, ask the cook and the blonde conductor who took in our dollars.

Dinner at Chicago, at the Grand Pacific, still resonant with the just departed footsteps of the delegates to the late Republican Convention, and then on to Milwaukee. The thermometer that we left at New York away up among the nineties, had gone down to the fifties, so that our reception at that city was both cool and warm, delightfully cool in our atmospheric environment, and delightfully warm from Milwaukee citizens. Supper and rest at the hotel, and then we were ready for "the economic use of time, power and matter."

You know all about the Convention sessions, the interesting and learned papers that were read there, and their spirited and animated discussions, but perhaps you don't know of how charmingly the ladies of the Convention were entertained, nor how delightfully they passed their time. Nor do you know all about the delightful reception that the Woman's Club of Wisconsin gave to the wives, daughters and lady guests of the members, so that we appreciated, as never before, the advantage of being a W., D. or L. G. of a member of the American Society of Civil Engineers. I own that my memory of this really most charming affair is that of a veritable Babel, where each and every woman endeavored to out-talk her fair neighbor and to drown the strains of the orchestra that played in wild opposition in one corner of the reception room, all at the same time. I know that my throat was sore and my voice hoarser than the legendary crow all the next day from the fruitless endeavor; but this did not in the least detract from our enjoyment of the opportunity to talk and to meet so very many of the charming ladies of Milwaukee; and, by and by, when the "gentlemen" came down, did not each and every woman exhibit her more or less noted masculine attachment, her H., B. or F., to her fair Lake City sisters?

The Athenæum building, in which the Woman's Club has its home, and where the sessions of the Convention were held, is a very pretty building. It was built, is owned and entirely controlled by women. The Women's Club itself is a social and literary club, quite unique, and one of the social features of Milwaukee, which has charming rooms on the lower floor of the building, a large parlor or reception room, where its social and literary meetings are held, a reading room, with the current magazines and a library of interesting books, a refreshment room, and a ladies' dressing room, in which, O ye masculine habitués of your luxurious clubs! on a warm and weary day, I found, beside the usual toilet appurtenances, the dearest, sweetest, most refreshing little box of perfumed powder and a puff, and was happy.

The reception at the Athenæum building, by the local members and their wives, with dancing and light refreshments, gave us an opportunity to dance the Benzenberg quadrille, the Belle telephone polka, the Edison electric lanciers, the Whittemore elastic limit galop, the Lawler pontoon quadrille, the Thurston torsional twist, the Francis centrifugal and the Sir John de Bogart.

Carriages at our disposal, to drive about at our own sweet will, for two whole days; a rendition of "The Bohemian Girl" at Schlitz's Park on Saturday evening, complimentary to the Society, a special carriage drive about the city and to the National Soldiers' Home; trips to Appleton, Kaukauna, Oconomowoc and Waukesha—all these features crowded our days at Milwaukee with enjoyment.

The banquet on Monday evening, in the large dining hall of the Plankinton, was perhaps the culminating event of the Convention. The large hall was comfortably filled with fair women and learned men, and presently the toasts and speeches began.

I wish I could reproduce for you the short, sparkling, pithy speech of our ever popular Secretary, the witty and original after-dinner speech of Mr. PERCIVAL ROBERTS, who responded to the toast of "Woman", the telling response of Vice-President CROES, or a part of the oratorical effort of Mr. COLBY, but the auburn-haired reporter in attendance did not take it down and I could not. It was sometime after midnight when the banqueting party broke up.

And now, are you not dying to know who was the belle of the Convention? Every year this point is tacitly agreed upon, and I hear the men discussing it among themselves. The women are not always of one mind upon this matter, of course, any more than are the men, as to who was the handsomest man, and who the cleverest, and who the dearest; (put down for the latter a dear old gentleman of eighty), but as to the others I shall not tell of this Milwaukee Convention, though we women had settled all those points from the very first. Well, the palm of beauty among the visiting ladies fell it was pretty well agreed, upon the wife of a representative of a rival Lake City, while equally as handsome was voted the wife of one of Milwaukee's influential citizens, formerly a New York girl. But the best loved and most popular of all the Convention ladies, is, and is always, a certain pleasant faced lady, whose hair is just beginning to silver, and whose charming presence is looked upon as one of the pleasantest features of nearly every convention.

An early rising on the morning following the banquet, a hurried breakfast, and quite a party started on the trip to Appleton, a town of funny contrasts, one hundred miles farther north. Here are immense paper and pulp mills, an electric railway, and streets as clean and as quiet as a wayback country village; a hotel with a printed menu, an electric lighted dining room, and electric bells, and in the lavatory a row of "roller towels" and tin wash basins. On the streets, a group of women who would be well dressed anywhere, some sad-faced Sisters, with their charges, a lot of regulation "Crackers", men and women, some unkempt children, and foreign settlers, jabbering away in Swedish, Finnish or I know not what. They say it is the cleanest city in the Northwest; certainly it was experiencing the most thorough washing on the day of our inspection, for the rain came down in torrents the greater part of the afternoon. Through the pouring rain, by boat, to Kaukauna, thence back to Milwaukee, completed the day. On the following day we visit Oconomowoc and Waukesha, where everybody must sample the water from each of the noted springs, with fireworks at the Soldiers' Home. Then we bade adieu to Milwaukee, the Cream City on the lake, watched over on the one side by the bronze shades of Juneau, its founder, and on the other by George Washington, the founder of us all, and the party separated, some returning by way of the "Soo," etc., to their respective homes, voting the Milwaukee Convention one of the most enjoyable of the series.

ENGINEERING NEWS

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D. McN. STAUFFER. A. M. WELLINGTON, EDITORS.

GEO. H. FROST, - - - BUSINESS MANAGER.

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Drawings and Photographs *of all new engineering works or designs, large or small, of interest from their magnitude, novelty or originality, as well as newly adopted* **Standard Plans** *for engineering structures or details, rolling stock, etc., are always desired for early publication. Also,* **Brief Technical Notes** *of the cost or manner of executing work, tests of materials, machines or other new devices, and* **News of New Construction** *of all kinds.* **Letters** *for publication must be accompanied by the name or card of the writer.*

Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Civil Engineers' Society, St. Paul, Minn. — Regular meeting, Aug. 6. Secy., G. L. Wilson, City Hall.

New England Roadmasters' Association. — The 6th, annual meeting will be held at Boston, Mass., August 15, 16. Secy.; W. F. Ellis, Roadmaster, Providence & Worcester R. R. Woonsocket, R. I.

American Association for the Advancement of Science. The thirty-seventh meeting will be held at Cleveland, O., from August 15 to August 21, 1888. The headquarters will be at the Hollenden. For particulars address F. W. PUTNAM, Salem, Mass.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, Aug. 21. Secy., S. M. Wickersham Penn Building.

Engineers' Club of Kansas City, Mo.—Regular meeting, Sept. 3. Secy., Kenneth Allen, 19 Deardorff Building.

American Society of Civil Engineers, New York.—Regular meeting, Sept. 5. Secy., John Bogart, 127 E. 23d St.

Roadmasters' Association of America.—Next meeting at Washington, D. C., Sept. 11. Secy., H. W. Reid, Waycross, Ga.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, Sept. 19. "House Drainage". Secy., S. E. Tinkham, City Hall.

Engineers' Club, Philadelphia, Pa.—Regular meeting Oct. 6. Secy., Howard Murphy, 1122 Girard St.

THE *Centralblatt der Bauverwaltung* takes us to task in a recent issue in regard to our editorial of Dec. 10, 1887, on "Some Needed Train Resistance Tests", claiming that the Germans have done much more than we gave them credit for in the way of train resistance tests, and especially that the tests made by Prof. A. FRANK on the State railways in 1883 covered substantially the same ground as that which we stated needed investigation. We must confess that we did not have those tests in mind when preparing the article, but we have since received the full report of them from Prof. FRANK, and published an abstract of them, and while they contain much that is new and interesting, they certainly do not cover the field laid out; besides which, the German rolling stock is so different from ours in many details that they are not directly applicable to American practice even so far as they go. The *Centralblatt* gently remarks that the Americans would save much work and racking of brains in many things if they studied German work with only a part of the care with which Germans study American work, which is no doubt true; but there are excuses for it into which we will not enter further than to say that when the final outcome of the most elaborate series of train resistance experiments ever made, as we believe it was, (the Royal Bavarian Railway Administration tests of 1875-6-7-8) leads only to such an absurd result as that train resistance is a function of v^3, ($R = 0.00021\ v^3 + 2.5$ for resistances in kilos. per tonne and velocities in kilos. per hour for the cars behind the engine, and $R = 0.00021\ v^2 + 5.0$ for the engine) as a result of a too vigorous "application of the method of least squares to 1230 experiments", it is apt to give one a dose which lasts him a long time, especially when he finds these results only given out in their final form to the public in 1880, and then endorsed by so eminent an authority as Baron M. M. VON WEBER who had studied technical railroading as carefully and long, perhaps, as any one then living.

THE above quoted formula may be seen in a moment to be an utterly absurd one. Take a speed of 100 kilos. per hour, or a little over a mile a minute. We have then a resistance of $100^3 \times .00021 + 2.5 = 212.5$ kilos. per tonne or 425 lbs. per ton of 2,000 lbs.! The accelerating force on a 4 per cent. grade being 40 kilos. per tonne, the highest velocity which a runaway train could obtain on such a grade would be

$$v = \sqrt[3]{\frac{40 - 2.5}{.00021}} = 56.3 \text{ per hour}$$

or about 35 miles per hour! Reducing the grade to 2 per cent. we get 27 miles per hour, and to 1 per cent. only a little over 20 miles per hour! Extending the computation a little further, we shall find that an ordinary passenger locomotive with 40,000 lbs. on the drivers and ¼ adhesion, will haul on a level only 131 tons at 30 miles per hour, 25 tons at 40 miles per hour, and barely its own weight at 45 miles an hour; yet this was put forth for science not by one man, even of Baron VON WEBER'S eminence, but by an entire railway administration, and not as the result of a few tests, but as the result of a long series extending over five years! This does not stand on the basis of a common error which further experiments may correct. It is the result of trusting more to a glorious abstraction like the method of least squares, than to one's common sense; and if our contemporary will allow us to say so without offence, such trust is so common in German technical work as to make it a dangerous thing to rely on, despite the vast amount of work which they put into such investigations. It is not always that the error is on so large a scale as to betray itself. The origin of the error in this particular case was easy to trace. Nearly all the tests were below 20 miles per hour. Owing to causes beyond the scope of the method of least squares, and not then so well determined as now, train resistance hardly increases at all with velocities up to 12 or 14 miles per hour, and then of course much more rapidly, so that the formula averages the truth below 20 miles per hour fairly well. If velocity had been the only cause of the variations below 20 miles per hour, the formula, perhaps, might have been safely extended, but it is not the only cause.

ENGLISH manufacturers and the English press are justly outraged—from a "free trade" standpoint—at the late action of the Government of New South Wales in letting about 50 passenger and freight engines to Sydney firms at prices about 30 per cent. in advance on engines imported from England. The complaint is made that the engines demanded were not English engines; that they had frames based on American types; that the fire-boxes were steel instead of copper; steel tubes replaced brass tubes; that copper chimney tops and brass domes were abolished, etc. But the unpardonable sin seems to be that even if these engines are cheaper and better adapted to the needs of the Colony that is to use them, the New South Wales Government has not acted in accordance with free trade principles in limiting the competition for these "modified and cheapened" engines to colonial firms.

THE fact of the matter is that some of England's colonies are growing, and with their material progress and distance from home they are disposed to cut loose from some of the traditions of the mother-country. The manufacturers of Great Britain have yet to learn that what "is best" in England is not always of universal application. But a few more "kicks" of this kind from England's ungrateful colonies will probably sweep away a little of that too sturdy conservatism which now holds sway in the "tight little island" and teach its engineers and builders that certain concessions in design and material are absolutely necessary to hold a trade which free-trade principles will not preserve too far away from home. New South Wales is now a great country and its people, though English and because they are English, have implanted in them a very healthy desire to foster manufactures among themselves, and no longer simply raise sheep and dig gold and send thousands of miles to England for all else they want. Their ambition is an honorable one, notwithstanding the outcry in England, and as a certain amount of "protection" seems just now best suited to their needs they have applied it and will doubtless extend its application. And England must before long take a little of the same medicine, or find the outside world flooding her with its products while her own workmen starve or emigrate to other shores.

WE are very glad to record that public opinion in Philadelphia, as represented by all the principal newspapers of the city, has condemned in most unsparing terms the outrageous action of the Railroad Committee of the City Councils in killing the ordinance granting a franchise to the Reading Terminal Company. The *North American* says:

> "The treatment of the Reading Terminal ordinance by the Railroad Committee of Councils is not exactly disappointing, for that it was the intention of a majority of the committee in one way or another to defeat the measure was apparent from the first; but it is discouraging. It is almost enough to make Philadelphians despair, who are proud of their city and anxious to have it keep in the front rank of progress."

It is really a surprise to see how strongly and unanimously the press of the city unite in their arraignment of the stupid or worse than stupid councilmen who deliberately killed the most important public improvement which the city of Philadelphia has ever had an opportunity to effect. It is to be hoped that for once the mild mannered and patient inhabitants of the city of Brotherly Love will awake to some proper appreciation of their rights and duties and will sweep the offending councilmen off the board.

THE past week has witnessed a marked revival in the stock market; the chief basis for which is the Government crop report. It seems that there is every reason to expect a corn crop this year which has never been equalled, and the business which this will furnish to the granger roads and the trunk lines is supposed to insure a favorable balance sheet to the railway companies by the end of the year. It is quite certain, however, that if the railways expect to make much money out of the handling of this heavy crop they had better

hurry up and come to some harmonious understanding on the matter of rates, especially in the Northwest and onthe routes between Chicago and the seabcard. So many of the roads in this section have been running close to their expenses for the first half of the year, that they will have to make some fat profits during the next six months if they expect to pay a dividend from this year's earnings.

THE Kutter fund continues to grow in a manner that proves that the faithful labors of this engineer are held in grateful remembrance by many members of the profession. We can only wish that the fund would more nearly measure in volume the just appreciation of Mr. KUTTER's worth and that spirit of fellowship and hearty generosity in a good cause which characterizes engineers. The fund now stands as follows:

Previously acknowledged		$682.
John L. Allison		5.
Fred C. Weir		25.
A Fteley		10.
Subscriptions received through Eaton & Lownes, Los Angeles, Cal., from engineers of that city.		
Fred Eaton	$5.	
Eaton & Lownes	2.	
Ass't's City Eng.'s Office	2.	
J. W. Robinette	1.	
L. Friel	1.	
John Goldsworthy	2.	
Alfred Solano	5.	
S. P. Jewett	5.	
W. R. Davis	1.	
W. A. Seymour	1.	
E. Lownes	2.	
Eaton & Lownes Ass't's	1.	
McClure Bros	4.	
W. D. Buckner	2.	
J. H. Dockweiler	3.	
Chas. T. Healey	1.	
R. Egan	1.	
E. T. Wright	2.50	
W. R. Flavin	2.	
B. S. Eaton	1.	
W. J. Rowan	2.50	
M. Kelleher	1.	
G. B. King	1.	
Aug. Mayer	2.	
Burr Bassell	2.	
Wm. Mulholland	1.	
Total		54.
R. S. H.		5.
W. B. Palmer		2.
"Cash"		10.
Otto Reizler		5.
Total		$758.

One of this week's contributors very properly suggests that it is not civil engineers alone who owe a debt of gratitude to Mr. KUTTER. Irrigation companies and users of water power very generally daily derive benefits from the works of this eminent engineer; and as their benefits are of a more substantial kind than that secured by the professional man, it would be a graceful and proper act for them to also remember the widow in her need. We heartily hope that this suggestion will bring fruit.

THE Paris *Economiste Francais*, of June 30, makes out a very dismal showing for the immediate financial future of the Panama Canal, based upon the very unsatisfactory reception of the last Canal loan. The *Economiste* proceeds to show that if the company has placed half the loan, or 1,000,000 bonds—an extreme estimate—it has only secured 360,000,000 frs. But this amount must be reduced by 40,000,000 frs. of the loan of March, 1888, exchanged and at least 25,000,000 frs. for expenses, and 30,000,000 frs. recently borrowed from credit establishments; this leaves 265,000,000 frs. Now under a solemn promise to subscribers to the new loan the Company is obliged to have six lottery drawings per year with prizes which will require an annuity of 3,390,000 frs.; to secure this the Company must, under its promise, place a capital of about 120,000,000 frs. in French *rentes*. Deducting this last sum from the amount remaining from the sale of bonds and only 145,000,000 frs. is left, and this is not at once available as the bonds are payable in seven installments with the last due in November, 1889. The Paris journal on this basis fixes the amount of cash available in the next four or five months as not exceeding 60,000,000 frs. a sum hardly sufficient to pay the interest account, and certainly allowing nothing for work on the Canal.

A Practical System of Rail Tests.

We have received from a correspondent the following inquiry, which explains itself, and which it will be far better to answer publicly than privately, both because we could not undertake to answer it privately as fully as is needed to do any good, and because the answer, which will probably be labor thrown away as respects any one individual, is much less likely to be thrown away when addressed to a wider audience:

"DEAR SIR: Having been recently appointed to a Fellowship in Civil Engineering in the University of * * * *. I write you at the suggestion of President * * *, to ask your advice with regard to the choice of some line of work for original investigation. I wish to take up some line in which I can profitably spend a year's work either in the laboratory or elsewhere. Any suggestions you will kindly make will be very gratefully received."

There is a field for original investigation precisely adapted to our correspondent's requirements; which should not be beyond the capacity of a young man able to command, after graduation, one of the few Fellowships of Civil Engineering which as yet exist, which badly needs investigation, and which requires only unlimited care, patience, exactitude and command of time, rather than long experience or profound knowledge or intricate apparatus. We refer to the determination of a rational and adequate system of distinguishing in advance whether a given steel rail will prove good or bad in service. No such system as yet exists, so far as has been made public, in any part of the world. We cannot undertake to guarantee that it can be determined by the method we are about to suggest, but we see no reason to doubt that it can be; and we can guarantee that the young man—or old man—who successfully determines it will immortalize himself in a small way, by rendering a service of great practical and scientific value.

It is a notorious and unquestionable fact that the great fall in the price of steel rails in the last ten or fifteen years has been accompanied by an almost equal falling off in quality. The rails which used to cost $160 per ton were vastly better than anything now in the market. The precise cause is unknown, nor need it concern us. It is in part unquestionably due to the use of inferior material; in part to less attention to minutiæ of manufacture; in part to seeking a softer rail than was really desirable; in larger part than all else, probably, to defects in the mechanical working of the steel, too hasty rolling, and what not. A strong evidence of the latter fact is that the very rails which fail almost immediately in service, and show a spongy, rotten and uneven fracture, can often be worked a little more under the hammer and show a clean, homogeneous fracture, and all the other properties of good steel.

The tests which are now applied to steel rails (when any are) may be divided into two classes, chemical and mechanical. All attempts to distinguish good rails from bad by chemical analyses have proved dismal failures, and it is likely *a priori* that they always will do so. There are so many elements in a rail, and so many different ores used in making them, that it is inherently probable that many different chemical compositions will be consistent with good quality, while the details of the manufacture exercise so great an influence that no chemical composition can ensure good quality. It has always proved so. Constant chemical analyses are an important guide to the manufacturer, but the most that they enable one to say of the manufactured rail is that it is certainly bad or *possibly* good.

The common physical tests are the following:

1. *Exterior inspection*, for flaws, length, weight, punching, etc.; a necessary precaution, which is more often than not the only real inspection, but which obviously tells nothing of the interior physical qualities. In fact, it is doubtful if too rigid attention to this kind of inspection only has not done decided harm, by leading manufacturers to too great efforts to turn out rails with flawless exteriors regardless of their interiors. To do this it is necessary to have the metal flow easily, but the metal which flows easily under the rolls is liable to likewise flow easily under the driving wheels. The slightest flaw in the rail now makes a "second." These "seconds" often prove to be excellent rails, and rarely break through the flaw or check which caused their rejection; but they cause manufacturers a loss which they do not like.

2. *Drop tests*, to test brittleness and strength, by far the best (in fact the only) test now available to show in advance whether a rail is good or bad. The drop tests which rails must stand to be safe in the track are now well determined, and must constitute a part of any rational system of rail tests; but by themselves they have only negative value. They exclude some of the bad, but do not admit only the good. Rails too soft for good service often stand drop tests well.

Beyond these, we have now only the following:

3. *Tensile or torsional tests*, to determine limit of elasticity, elastic modulus, reduction of area, ultimate strength and what not. These are rarely resorted to except in supposed very careful inspection, and it is just as well they are not, because they are absolutely worthless as a guide to quality, except negatively, to see if rails are very bad, which is shown equally well by the drop tests which also show more, since no material of low tensile strength will stand good drop tests.

The pitiably careless way in which the question of rail inspection has been studied is shown by nothing more conspicuously than by the use of tensile tests in any form for practical rail tests. For structural iron they are precisely what is needed. They imitate very fairly the strains to come in actual service. Metal which stands them well will do equally well in a bridge or a beam. But what are the qualities which we require in a rail? Plainly these three, and these only:

1. It must resist deformation of section by mashing or flowing in service.

2. It must resist abrasion and surface wear well.

3. It must not readily break.

When we get these we have all we want. We do not care what the tensional or torsional strength is, or the modulus of elasticity, or the chemical composition. These may be what in other kinds of steel would be very inferior, but if *the three qualities required* are not injured our rail is no worse, while some of the poorest rails ever put in the track have shown up beautifully when put in the testing machine. Hence the rational way to test a rail, and, in our judgment, the only effective one which will ever be devised, is to *test directly for the qualities required*, and of such tests we now have only one, the "drop test", for requirement No. 3. The others, in our belief, may and ought to be determined as follows:

Deformation of Section in service, especially at the joints, ruins more rails than both the other causes together, and is practically the only cause of very short life. A partial remedy would be better rail joints, but that question we are not discussing.

The natural method to test against deformation under pressure and impact is by measuring the deformation under still severer conditions. The cold-chisel in every tool-chest fur-

nishes an off-hand apparatus, and every section boss has more or less skill in judging of rails by this test. We believe it, even in this crude form, to give truer evidence as to this vital quality than any one or all of the recognized laboratory tests. To convert the test into one of precision three things are necessary:

1. A cutting instrument which can be exactly reproduced. This can be most readily obtained by a conical prick punch, pointed at an angle of 60° or 90°, flattened at the point by a specified small amount, and made and tempered in a specified manner. Any of the best tool-making firms will make and reproduce these with practical exactitude. No others should be trusted.

2. An exactly uniform impact, which can be obtained by a perforated block of wrought-iron of specified form and weight, falling a specified number of inches on a rod attached to the test punch.

5. At least 50 different samples of 25 different rails, some of which have proved in service to be good, and some of which have proved to be bad, as respects this one quality.

The precise proportions which would be best for this simple apparatus would be a matter for some preliminary experimentation, but whatever the proportions, it does not admit of doubt (because the cold chisel proves it) that a very decided difference would be observed in the amount of penetration from a given number of impacts into good rails and into bad ones. There might be no sharp line of demarcation, or gradation directly in proportion to supposed badness, but there would be a point of demarcation which none of the good rails would reach, and some of the bad rails pass, which would give an inferior limit below which a rail was certainly bad, and in all probability a similar superior limit, above which a rail might certainly be classed as good, in this one respect.

Rails thus tested, however, would necessarily have been in service, and have been "pened" and possibly hardened on top thereby. Tests on the bottom and sides of these rails would afford opportunity to compare the worn and unworn surfaces, and tests of new rails on top, sides and base would afford evidence as to whether these surfaces should normally test the same. To eliminate all these doubtful points would require a patient and systematic comparison and multiplication of tests which, it is to be feared, few men without special training in, and aptitude for, such work, would know how to do systematically enough, but which certainly would not demand any profound knowledge or experience. The main thing is to be prepared for contradictory results, and to hunt out and eliminate their cause.

Rail wear proper—abrasion and its various causes—is an item of almost minor importance, except on curves. Eliminate the first and third defects alone, and the poorest rails will wear so long that to double their life again is no very large economy per train mile. Yet it is always an important consideration, and on curves very important. To test for it effectively we must first determine its causes.

Three possible causes for abrasive wear are apparent, (1) direct grinding friction, as on curves, (2) rupture or tearing of the fibres due to their interlocking, (3) destruction of texture by crushing. Considerations which we cannot now go into in detail indicate strongly that practically the only cause of loss of weight by wear is direct grinding friction, both on curves and tangents. Why this should be so on curves is apparent. But both on curves and tangents there is of necessity constant sliding. No two wheels are of the same diameter, and if they are at first they do not stay so. No two axles are exactly parallel. No center-pin permits the truck to exactly align itself. The oscillations from side to side are constantly going on, and each requires a twist of the truck, while it also varies the diameter of the wheels. These and other like causes produce an unknown amount of tangent sliding, which may be called x. On curves there is a computable amount, which may be called a. Now as rail-wear from sliding is probably proportional to the amount of sliding, and as the comparative rail-wear on curves and tangents is now pretty well known, it will be seen that it is readily computable by a simple proportion how much sliding wear on tangents there must be to account for the whole of the tangent rail-wear in that way alone.

Without now going into details, such a comparison shows clearly that about all the tangent wear may be thus accounted for, as might be expected from the known fact that there is a good deal of surface sliding, and from the difficulty of accounting for much wear by the other two causes. So far as the second cause is concerned, moreover, interlocking of the surface fibres, the wear, whatever there is of it, must be of substantially the same nature as the coarser kind of sliding we have been considering. To interlock without grinding, the fibres would have to be epicycloidal cogs. Magnify the fibres in imagination to the size of cogs, and we shall see at once that this kind of wear also must be for the most part grinding wear.

The third possible kind of wear, direct crushing of the material, we discussed a month ago in speaking of "Crushing Strength per Square Inch." It is enough to say now that there is not the slightest reason to believe that the actual pressures of 40,000 to 70,000 lbs. per sq. in. on very small bearing areas, protected by a mass of material on all sides, can cause the slightest injury to the material by direct pressure. Our tabular "crushing strengths" have no relation to such conditions.

It follows, at least, that by far the larger portion of the wear is an effect of mere sliding abrasion, and the obvious way to test for this is by subjecting the rails to a quick form of sliding abrasion. The simplest way to do this is to run one rail upon another and let them grind into each other. To exactly imitate the conditions of service the pressures should be equally high, but until the contrary is proved by tests (as it may be) it is a safe preliminary hypothesis that there will be the same relative endurance under light pressures as under heavy ones.

The neatest way of test would probably be to cast a small chilled wheel of car-wheel metal, say 12 ins. diameter by 1 in. grinding face, put it in a mandrel and put that on a lathe, and put two pieces of the rail to be tested above and below, pressing them together by a constant pressure (easily arranged for) and noting the wear after a certain number of thousand revolutions. Here, also, possible sources of error from difference of speed from leaving or removing the abraded particles, from testing new rails or old rails, from different qualities of chilled wheels, and from testing the head or base of the rails, would have to be carefully eliminated by many tests before the results would become general or reliable. By having a sufficient number of rails which had worn little and much in actual service, however, it may be expected with some confidence that superior and inferior limits like those above spoken of for deformation, could be determined for abrasion likewise, and any one in any part of the world could then adopt the specification and repeat the tests.

The other and simpler way spoken of for accomplishing the same end would be to take two pieces of the rail to be tested; fasten one on the bed of a shaper, turn the other head down upon it; attach it to the moving arm of the shaper with suitable appliances to keep it horizontal; load to a constant weight, and then let the two pieces of rail saw into each other for a specified number of motions, determined by a counter. Possibly this might prove the better way, as well as the simpler. Both ought to be tried. By one or the other, after a sufficient number of failures from not having the right conditions, success must be attainable.

With two tests thus determined and, with drop tests for frangibility, we have a perfect specification for the qualities of rails. It will then become the manufacturers' turn to "walk the floor" to find out how to make rails to meet them—and they will not walk long. They are now in a hard position. On the one hand they must keep down the cost of rails; that is their particular duty and office. On the other hand, they have no means of telling precisely what the requirements are, nor whether they are meeting them. The very men who buy their rails do not know, and hence either buy rails blindly on trust, or devote their energy to hair spliting exterior inspection, or go into the foolishness of chemical specifications which bother the manufacturer without ensuring quality, or helplessly resort to tests borrowed from another art, that of producing metal for bridges and roofs, which have no relation whatever to the qualities required of a rail.

Tests of this kind ought to have been determined long since by some of the railway companies who are heavy buyers of rails, but they have not been. On the contrary, some of the heaviest buyers of rails are extremely careless, and none of them are so careful as to be sure of the rails when they buy them. If our correspondent or any other reader is anxious for a field of labor which will be profitable both to himself and mankind at large, he cannot find a better one than this: and if we are satisfied that he is willing and able to do the work properly, we are quite ready to undertake to procure for them a full supply of the raw material for experimentation, in the form of rails which have proved both good and bad in service.

The Design of Wooden Trestles.

The comments as to some details of wooden trestles which we publish elsewhere, raise a number of points which it is well should be discussed in regard to these structures, for it is certain that wooden trestles will be a prominent feature in American railway practice for some decades yet to come. Without attempting to discuss the whole trestle question broadly there are certain statements therein which seem to require some comment.

As between the three main methods of framing, mortising, doweling and "split" caps and sills, we fear it is true that mortising is at least as common as it ever was. We cannot but regard this as unfortunate, the true method of framing being, in our judgment, for trestles of any size but the smallest, to use both split caps and split sills; say two 6x12 in sticks for each, gained into the posts about 2 ins. on each stick, bringing them 4 ins. apart. This leaves 8 ins. at least of the post for a bearing surface, and that the most solid part of the stick, reinforced on the outside by 12 ins. more of timber, which is alone capable of carrying the load. The advantages of doing

this are not alone the two mentioned by our contributor, but also that any stick in the whole structure may be renewed without disturbing the rest of it, and thus the whole may be kept continuously in good order. Otherwise, the temptation to let a few bad sticks take their chances, when all the rest of the structure is good, is a great one, too frequently yielded to.

For structures too small to make it worth while to renew one stick before another, this argument loses its force; but even for them, what is gained by using mortises? An *appearance* of greater rigidity only, a certainty of affording greater chance for early rotting, a slightly more expensive structure, and a little greater stiffness in erection only. The latter is, we are convinced, the chief reason why morties are so generally adhered to, but that the undoubted contrast in erection does not continue after erection should be clear after brief reflection.

The chief transverse rigidity after erection comes from the sway-bracing, which is only then spiked on. This process of spiking on plank seems to Europeans a crude way of stiffening a structure, but it is really a most effective and permanent one, and spiking is an infinitely better and stiffer way of putting on the sway-braces than bolting. The batter posts being in bearing before the sway-bracing is spiked on, the two work together very well, but a moment's reflection will show that after the structure is once complete there is no possibility of tensile strains in a batter post, as there is during erection, so that the greater stiffness of the mortised bent while erecting should not be allowed any weight; nor is it, for that matter, sensibly stiffer than split caps and sills, although it is stiffer than a doweled structure.

As for the mortise joints themselves lending any stiffness to the structure, that is absurd, whether one, two or a dozen pins be used; and it is almost equally absurd to assume that because a dowel is in a sense a tenon, therefore there is equal chance for rotting. The dowel, properly put in, fills the hole in which it is driven completely, especially if grease, tar or paint be used, as they should be, to fill all possible small cracks. The mortise and tenon on the other hand are never a tight fit, and leave considerable voids both in the bottom and at the sides.

As for split *vs.* solid caps and sills, what is the cap for? Plainly, for three ends; (1) to hold the posts in the right position at the top, (2) to distribute the load to the other posts somewhat, if one of them settles; (3) to afford a bearing for the stringers. The first end is secured as well with the split cap as with a solid one. The second end may not be quite so well secured at first, but there is little difference, and after the cap has begun to rot it is secured better. The third end seems to be less effectively secured, since there are two kinds of bearing surface instead of only one, and it is undoubtedly difficult to make two independent modes of support act together; but there is in all 8 ins. of post and 8 ins. of cap for bearing surface, against 12 ins. of cap surface only; and with material so compressible as soft timber it is probable that the bearing surface soon adjusts itself so that the whole of it is available, giving a much more direct application of the load to the posts that are to bear it than the mortised cap.

Similarly, the sill has the same three offices, in substance, with the important difference that the foundations are often very imperfect, so that the second office becomes an essential one. Too many trestles are put up by simply scraping off some of the top soil, laying down a course of 4 in. to 8 in. mud sills, and resting the sill on that, drainage being almost left to take care of itself. It is a barbarous and indefensible mode of construction, and if it is to be followed, we may admit that the solid sill is indispensable. But the increasing modern practice is to use only two styles of foundation for trestles, (1) piles, driven to not over 3 ins. penetration under a heavy hammer, which is always good, and (2) a solid masonry or concrete foundation like those illustrated in our issue of June 23, which cost but little, and should certainly always be used when piles are not, unless the natural foundation is rock or hard-pan. In either of these cases the split sill attains every desirable end as to strength and stiffness, with the further one of leaving the condition of all the timber readily ascertainable and making renewal of any stick at the first sign of failure easy.

The weak point of almost all trestles is the floor, which is almost invariably wretched, the reason being that few constructing engineers have any realizing sense of operating dangers from experience therein, and feel that anything more than is required to take proper care of wheels on the track is a mere waste of money. How common it is to see trestles, especially short ones, with only 8 ft. or 10 ft. ties 8 to 12 ins. apart in the clear, and perhaps with a guard-rail on their ends to take off so much of the effective length. It cannot be too often insisted that this is excessively bad practice. The ties should never be less than 12 ft. long, *especially on short structures*, and never spaced more than 6 ins. apart in the clear, for the reason that it is the *entrance* of derailed wheels on a trestle which makes the trouble, and there is just as much entrance to a short structure as a long one. The governing idea should be: "Wherever else derailed cars come to grief, it shall not be on this structure", both because the danger is greatest there and because it costs so little to provide for safety. By making the ties 12 ft. long, there is room on the outside for a guard-rail, and yet leave space which will insure that wheels which have been passing along safely on the road bed shall not come to grief on the structure. When flaring guard-rails are used, of course, the main guards may be brought in nearer to the rails, especially if re-railing guards are also used, as in our judgment they should be at every open structure, long or short; but otherwise there is more danger in bringing guard-rails close to the rail than there is gain.

The use of such long ties necessitates, of course, that besides the main stringers there shall be outside ones, on each side, to support the ends of the ties, and these also should be always used. It is a poor and pitiful economy which does otherwise. The stringers, likewise, should always be "split", so as to break joints, and span over three bents. With bents 15 ft. apart, six 7x16 stringers, 4 of them for the main stringers bolted together in pairs, and the other two for outside stringers, are the least that should be used, and the same for any smaller openings. The use of long split stringers is too often neglected. We know of one case from personal experience where they saved a bad wreck: The foundations of one bent (put in in the wretched way we have objected to) were completely washed out, and the bent was hung almost completely from the stringers, yet such a floor as we have described had sufficient stiffness to carry a train safely over the span of 30 ft. The trainmen were badly frightened by the settling, but the track did not give way. The outside stringer happened to be continuous over the side of the trestle which was most undermined. Otherwise, probably, a very bad wreck would have resulted.

Not the least advantage of these wide floors is that it gives men caught on the structure a chance for their lives. It is a too frequent omission to neglect provisions for such danger, as also for hand cars by such turnouts as we illustrated in our issue of June 9.

How such a floor as this is fastened down to the bent is a minor question. The better way however, is probably by bolts passing through the caps, and never by drift-bolts, which makes it almost impossible to remove a stick. One of the minor points which is singularly often neglected is to use cast-iron packing washers between the stringers in place of oak or other wooden packing blocks, which create much more tendency to hidden rot.

The question of how a trestle can be best connected with the banks is much disputed. It seems like more solid and permanent work to put in a low end bent. We do not believe this is good practice. Heavy end mudsills which settle with the bank seem a more correct construction in every way. Otherwise, only constant work will enable the surface to be kept good in passing to and from the structure. As every engineer knows, this latter is one of the most difficult things to ensure at best, even after the track has been in use some years.

PERSONAL.

W. L. ESTABROOKE has been appointed Superintendent of the Monson R. R., in Maine.

ROBINS FLEMING, C. E., has resigned the position of Instructor of Civil Engineering in Lafayette College, Easton, Pa.

H. C. IVES, General Manager of the St. Paul, Minneapolis & Manitoba R. R., has withdrawn his resignation.

J. T. CHAMBERLAIN, formerly with the Boston & Albany R. R., has been appointed General Superintendent of the car shops of the Boston Stock Car Co.

JOHN N. DUNN, of Atlanta, Ga., President of the new Atlanta & Florida Railroad, died at his residence in Atlanta on July 16.

ROBERT LAW, Superintendent of the Montana division of the Northern Pacific R. R., has been appointed Assistant General Manager of a new division, extending from Billings to Heron, with headquarters at Helena.

C. COX, of Alexandria, Va., of the Engineer Department of the Piedmont Air Line, was among the killed at last week's fatal accident on the Virginia Midland Railway.

DAVID CARROLL, the inventor of the stump puller now in universal use among farmers, and of the ingenious instrument used in calculating the log of sea vessels, died near Meadville, Pa., July 13, aged 65.

ROBERT G. HUGHES, connected with the Rogers Locomotive Works, at Paterson, N. J., died at Paterson, July 15. His father, R. S. HUGHES, is General Manager of the works.

E. R. DOUGHERTY, Espanola, N. M., Superintendent of the Texas, Santa Fé & Northern Railroad, has resigned his position and will devote the balance of the season to looking after his mining interests in Crown mountain and in the vicinity of Ironton. He will be succeeded by E. LEWIS,

J. J. R. CROES, M. Am. Soc. C. E., has been chosen by the Water Committee of Syracuse, N. Y., to make a thorough investigation of the several sources of water supply that have been proposed to furnish an additional supply.

THE Tioga Branch of the Erie Railway, from Elmira to Hoytville, Pa., has been made a separate division of the road, with E. P. KNIBLOE as Superintendent. Superintendent KNIBLOE was transferred from the Western Division, J. H. PARSONS having been appointed Superintendent of that division in his place.

Col. O. N. LULL, a resident of Chambersburg, Pa., who was Superintendent of the Cumberland Valley R. R. from 1850 to 1873, died at his home July 15; aged 60. He was Master Mechanic of the road for many years, and held several other important positions.

VERMEULE and BIEN is the name of a new firm of Civil and Mining Engineers just established at 78 and 80 Broadway, this city. Mr. C. C. VERMEULE is a graduate of the class of '78, Rutgers Scientific School, and

has been for nearly ten years in charge of the Topographical Survey of New Jersey, which was inaugurated and has just been successfully completed under the adminstration of Prof. GEO. H. COOK, State Geologist. He has recently resigned his commission as Topographer of the United States Geological Survey which he has also held for four years.

We have frequently had occasion to call the attention of the readers of ENGINEERING NEWS to the excellent, work done by the New Jersey Survey, and as the surveying, mapping and publication of the entire survey has been under the supervision of Mr. VERMEULE, he is entitled to be considered an expert in this branch of the profession. He further brings to bear a knowledge of the country in the vicinity of New York, which will no doubt be of great use in location. MR. JOSEPH R. BIEN, his partner, has also been connected with the United States Geological Survey and recently completed a survey of Yellowstone Park. He is a graduate of Columbia School of Mines and will attend more especially to the mining business of the firm.

T. S. NEWCOMB, who has been division engineer on the Kansas City, Memphis & Birmingham Railway, with headquarters at Memphis, has resigned his position and has been appointed division engineer on the Louisville, St. Louis & Texas Railroad, with headquarters at Spottsville, Ky.

HIRAM SIBLEY, who died at Rochester, N. Y., on July 12 was one of the first men prominent in the building of telegraph lines in this country. He was instrumental in organizing the Western Union Telegraph Company in 1856 and was its President for the first ten years of its existence. He built the first transcontinental telegraph line in 1861. He was also largely interested in railways in the South and West. MR. SIBLEY did a munificent work for the cause of technical education in founding the Sibley College of Mechanic Arts at Cornell University, which he endowed with $150,000.

Col. B. W. FROBELL, Chief Engineer of the Macon & Covington R. R., died July 12,at Monticello, Ga., aged 56. He was born in Alexandria, Va., graduated at West Point and was appointed to a place in the United States navy, where he served until the war came on. He left the United States navy and entered the Confederate navy. He was afterward transferred to the Artillery and Engineering Corps of the army, where he served with distinction throughout the war. At the close of the war he was appointed United States Engineer for the Northern District of Georgia. While here he worked to build a canal from the upper Chattahoochee to Atlanta, but failed by one vote to get an appropriation from Congress. About two years ago he was chosen as Chief Engineer of the Macon & Covington R. R., which position he held until the time of his death.

The *Mining and Scientific Press* of San Francisco, of recent date, publishes a portrait and a short sketch of the professional career of CALVIN BROWN, at present a consulting engineer for numerous private corporate enterprises in California, but who for over half a century has been in the active practice of civil engineering in many parts of the country. Born in 1816, at Roxbury, Mass., Mr. BROWN commenced his professional service at 18, in Boston, where he had a valuable experience in hydraulic engineering and dock-building, being associated with LOAMMI BALDWIN, S. M. FELTON, Capt. ALEX. PARRIS, and Prof. JAS. HAYWARD of Harvard University. Mr. BROWN was also engaged in extensive railroad surveys in the South and West, and in the service of the U. S. Government designed the machinery for many uses in the Navy Department, and superintended the erection of many Government buildings. In 1861 Mr. BROWN was ordered to duty at the Mare Island Navy Yard, where he has remained ever since. He built the first large dam for the Spring Valley Water-Works, and designed and located the ship canal and locks of the Willamette Falls in Oregon.

General Manager SANDS, of the Norfolk & Western R. R., has announced the following changes: Superintendent of Eastern Division from Norfolk to Crewe, E. L. DE BARRY, headquarters Crewe, Va.; Superintendent of Lynchburg Division, from Crewe to Roanoke, J. C. CASSELL, headquarters Roanoke, Va.; Superintendent of Radford Division, from Roanoke to Bluefield, J. A. HARDY, headquarters Roanoke, Va.; Superintendent of Western Division, from Radford to Bristol, including the Cripple Creek Extension, J. G. OSBORNE, headquarters at Radford. General Agent N. M. OSBORNE has appointed W. L. KEEN Division Engineer at Norfolk. N. L. SNOWDEN has been appointed Supervisor of the Eastern Division, with headquarters at Petersburg. W. H. STANLEY has been appointed Supervisor of the Lynchburg Division, with headquarters at Lynchburg. B. E. MAXON has been appointed Supervisor of the Radford Division, with headquarters at Radford. B. F. STANLEY has been appointed Supervisor of the Western Division with headquarters at Wytheville. H. N. CRAGE has been appointed Supervisor of the Cripple Creek Extension, with headquarters at Radford.

Sewage Disposal and Microbiology in Paris.

At a recent meeting of the Paris municipal committee on public hygiene and the sanitary conditions of the Department of the Seine the question of sewage utilization was under discussion. The Prefect of Police had proposed the following questions to the committee: (1) The utilization of sewage water as at Gennevilliers, and the effect of the adoption by the French Senate and Chamber of the law now before these bodies proposing a general agricultural utilization of sewage water; will it be dangerous from the standpoint of public health? (2) In connection with the better preservation of the waters of the Seine, is any better system known? (3) The system of consigning *all* sewage to the sewers practically conforms to the municipal ordinance of Feb. 28, 1887. Does this method of carriage endanger public health? (4) Is there any system of removal of night-soil known which offers less annoyance or danger to public health?

As reported in *Le Genie Civil*, M. PASTEUR was the first to reply to the questions submitted, practically as follows: He did not think that the spreading of Paris sewage and the total waste products of that city upon the fields of Achres was in harmony with the present progress and our knowledge of hygienic laws. A new science is born, and its progress is such that it commands attention throughout the world. Under its impulse surgery and medicine are changing their methods; and it has brought about a veritable revolution in our knowledge of virulent and contagious diseases, and these maladies cover the whole range of practice, excepting only the group of hereditary nervous diseases.

M. PASTEUR laid down the principle which ruled microbiology as follows: The virulent and contagious maladies are never spontaneous; they all have for an origin a leaven of a living disease, an atom living a life of its own, a microbe. Destroy the microbes of typhoid fever, of diphtheria, of scarlatina, etc., or place them under conditions where they can do no harm, and you will prevent the re-occurrence of the disease. On the other hand, the spontaneous generation of microscopic life is an idle fancy, and all virulent and contagious diseases arise from the presence and development of these microscopic living atoms.

With these principles stated, and deemed undeniable by M. PASTEUR, he thinks that when an attempt is to be made to restore the purity of the stream which now receives all the germs of the many contagious diseases which disseminate the great city of Paris, it would be better to destroy these germs or check their influence for evil, rather than to accumulate them year by year upon fields lying at the gates of the city, and upon fields which are to be cultivated. It would be much better to conduct the sewage to the sea, where it would do no harm; or, at least, leave the fields untilled so that the germs might not again spread through Paris in the products from these fields.

In the scientific discussion following M. PASTEURS' remarks, M. ARMAND GAUTIER said that as the porcelain filter could not stop the passage of microbes, it was folly to suppose that the earth could accomplish this end. At Berlin, after some years of utilization, the authorities had to change the place of deposit, for the fields first used were completly saturated.

MM. ALPHAND, PROUST and ROCHARD, on the other hand, opposed the allegations of MM. PASTEUR and GAUTIER. M. ALPHAND cited the water analyses of M. MIQUEL made in Nov., 1887. The water of the Seine enclosed at Ivry, in a certain unit of volume, 5,760 bacteria; at the bridge of Austerlitz there were 12,000 and in the sewage water, 38,800 bacteria in the same unit volume. After the passage of this water through the soil the greater part of these microbes disappeared, for the water in the drains from the sewage farms contained only 54 bacteria at Asnieres and 915 at Garenne On the other hand investigators have found in the head waters of the Vanne 115 bacteria, and 595 in the water of the Dhuys, per unit.

The Committee finally voted, 24 to 7, that there was no danger to public health in the spreading of sewage upon the land; but the discussion is not yet ended as it is already announced that the question is to be raised again at further meetings. *Le Genie Civil* very sensibly remarks that the danger or harmlessness of the utilization of sewage on lands depends essentially upon the nature of these lands, the surface and its filtering properties; conditions somewhat difficult to reconcile with each other. The question of carrying all the sewage through the sewers is one intimately connected with the construction of these conduits and their gradient and section.

The Artesian Well in the Place Hebert, Paris.

The full account given of this great well, in our issue of June 16, is supplemented by some additional details, furnished us by a correspondent, which, on account of the magnitude of the work, will probably be of general interest.

This well, the largest and deepest of the three great artesian wells, bored by order of the municipality of Paris, has a depth of 2,359 ft. below the street level, or 2,193 feet below the surface of the sea. It is 367 feet deeper than the well at Passy, and 543 feet deeper than the well at Grenelle, both places being suburbs of Paris. It has taken twenty-two years to complete this new well, the total expenditure footing up to $480,000. Since the work is completed and the money spent, fears are entertained by the Parisians lest the new well will cause a diminished water supply from the older two wells. But as the temperature of the water from La Chapelle is 95 deg. Fahr., or warmer by 13 deg. than the water from the Passy and Grenelle wells, there can be little doubt but that the new well is supplied from an entirely different water-bearing stratum. When, in 1857, the Passy well was opened, two miles from the older well at Grenelle, it reduced the flow of the latter from 135 to 100 galls. per minute. This circumstance, coupled with the fact that the water in the two wells is of the same temperature, 82 deg. Fahr., proves that both draw their supply from the same stratum. The diameter of the new well at La Chapelle is 5½ feet at the top. It was commenced in January, 1866, and by November, 1869, a depth of 1811 ft. had been reached. From then to the final completion the rate of progress made was slow.

The well of Passy, which was begun in 1854 and completed in 1861, was driven to a depth of 1923 ft., the diametcr being 28 ins. It sends up a continuous stream of water, at the rate of 4,000 galls. per minute, to a height of 54 ft. above the ground, supplying the whole village of Passy with water. Besides these large wells, there are in the Paris basin a great many others, varying from 300 to 400 feet in depth, and from 2 to 8 ins. in diameter.

Water Supply in Italy.

An inquiry into the sanitary condition of dwellings in Italy has brought out the following result: 2,491 communities with a population of 6,196,584 persons use only spring water; 1,583 communities with a population of 5,965,703 use well water; 130 communities with 721,893 persons use exclusively cistern water; 1,321 communities with 7,026,229 persons are provided partly with cistern, well and spring water; 946 communities with 2,301,803 persons use river water, and 79,154 make some use of sea water.

Spring water mainly is used in Liguria, Latium, Sicily and Sardinia; the use of well water prevails in Piedmont and Lombardy; cistern water is mainly relied on in Tuscany, Campana and Apulia; river water is used mostly in Venice and in the plains.

2,720 communities obtain their drinking water in pipe systems of metal, wood, cement or vitrified clay. 447 communities get it in open channels and 614 in lead pipe exclusively. It was found that 673 communities with 22,434,735 persons had a sufficient supply, and 1,495 communities with 6,024,375 persons had an insufficient one.

With respect to the quality of the water, the inquiry showed that 81 8 per cent. of the population with an amply supply, had good water, 13.1 per cent. tolerable and 5.1 per cent. bad water. Of the population with an insufficient supply 56.3 per cent had good. 25.5 per cent. tolerable and 18.4 per cent bad water.

Regulating the Water Supply for Mills.

It frequently occurs, in the case of small rivers or creeks, when dammed and used for power purposes, that the upper mills use all the stored water during a few hours of the day and shut down the wheels during the remainder, thus often injuring the proper supply of the water for the mills below. A case involving this question, which caused years of litigation, was recently decided in Austria*. The courts maintained that if a riparian owner stores the water for his use above his mill, and thereby reduces the quantity below the average flow, he shall be obliged to construct storage reservoirs below his mill of sufficient capacity, and to regulate, at his expense, the discharge of these reservoirs, so that the mill owners below receive the water as nearly as practicable as it would reach them under natural conditions, *i. e.*, as though the upper mill did not exist.

ENGINEERING NEWS.

IT is now practically settled that the elevated railway on the South Side, Chicago, Ill., over which there has been so much controversy, will be built. All doubts were removed on July 19 by the deposit with the City Treasurer of the $100,000 forfeit money required by the amended ordinance. This is the line which is to be built through the alleys.

A LARGE astronomical observatory is to be built at Denver, Col., an especially desirable location on account of its freedom from bad weather, statistics showing that only 15 per cent. of the days are cloudy. The money is said to have been provided by W. B. CHAMBERLAIN of New York. The dome of the building will be 30 ft. in diameter, and have two apertures for observations. Its frame will be of iron and steel and the roof of galvanized iron, the weight of the whole being about 12 tons. It will be supported on wheels arranged to run on a circular track, so that it can be rotated about its vertical axis with very little friction. The object glass of the equatorial telescope will be 20 ins. in diameter and the length of the steel tube 26 ft. A very accurate driving clock is to be attached to the telescope. The site of the observatory is about 1,000 ft. higher than the famous Lick observatory, at Mount Hamilton, Cal.

THE following tables show what has been done in New York and Brooklyn in the last six months in the way of building, and how these figures compare with those for the same period in 1887:

New York.

	1887.		1888.	
	Build'gs.	*Cost.*	*Build'gs.*	*Cost.*
Jan	168	$2,610,190	117	$1,944,385
Feb	382	6,366,530	203	2,216,005
March	887	13,528,450	311	5,228,919
April	644	11,082,395	373	5,311,976
May	426	6,905,550	351	5,971,185
June	406	6,822,625	282	4,851,118
Total	2,923	$47,315,140	1,647	$25,524,678

Brooklyn.

Jan	199	$764,855	179	$754,895
Feb	280	1,117,425	269	1,219,509
March	475	2,125,033	344	1,601,298
April	434	2,138,390	412	2,253,789
May	477	2,449,865	541	3,078,120
June	409	2,250,471	371	3,856,837
Total	2,274	$10,845,979	2,117	$12,764,448

IT is reported that the plan of bridging the Mississippi at Chain of Rocks, just above St. Louis, is soon to be executed. The Merchants' Bridge Company has not been making very rapid progress with the project until recently, when the North St. Louis Business Men's Exchange took the matter up and proposed to take $500,000 worth of stock in the enterprise provided the bridge be made a foot and wagon as well as a railway bridge. The estimated cost of the railway bridge is $2,000,000. The wagon roadway will probably make an additional expense of $500,000, making a total of $2,500,000. A net additional income of $50,000 per annum, it is estimated, will be the result of the addition of a carriage-way The Merchants' Bridge Company is making a strong effort to get the work under way this season.

*A rolling mill used the water only after the discharge of a furnace, and stored it during the rest of the time.

PUBLICATIONS RECEIVED.

A Practical Treatise on Bridge Construction, being a Text Book on the Design and Construction of Bridges in Iron and Steel, for the use of Students, Draftsmen and Engineers. By T. CLAXTON FIDLER, M. Inst. C. E. London: Charles Griffin & Co. 8vo., pp. 432 and xxiv. 237 cuts, 12 folding plates. Scant index. $—.

We reserve this valuable and elaborate work for further notice, commending it as one with many admirable prints which should be in the library of every engineer.

The series of Railway Articles in *Scribner's Magazine* has met with the most gratifying reception, and the publishers have received many letters from all over the country congratulating them upon the way in which the scheme has been carried out. The third of the series, entitled "American Locomotives and Cars", by M. N. FORNEY, will appear in the August number, and will be entirely different in subject-matter, treatment, and illustration from the two preceding articles, which dealt with the construction of the road-bed. Mr. FORNEY will describe the evolution of the modern locomotive from PETER COOPER'S engine, which weighed less than a ton, and the typical passenger car from the old stage coach.

SOCIETY PROCEEDINGS.

American Society of Civil Engineers.—List of Members, Guests and Visitors present at the Annual Convention of the American Society of Civil Engineers, Milwaukee, Wis., 1888.

Members and Guests.

T. Appleton, Milwaukee.
Mrs. Appleton.
S. G. Artingstall, Chicago.
A. B. Atwater, Detroit.
Mr. Atwater.
J. W. Bacon, Danbury, Ct.
Mrs. Bacon.
T. W. Baldwin, Bangor, Me.
R. Bassel, Washington D.C.
Onward Bates, Milwaukee.
Miss Bates.
Max. J. Becker, Pittsburg.
G. H. Benzenberg, Milwaukee.
J. Bogart, (*Secretary*), N.Y.
Mrs. Bogart, Miss Crans.
D. Bontecou, Kansas City.
Mrs. Bontecou.
W. F. Booth, Poughkeepsie, N. Y.
C. Breckinridge, Covington, Ky.
Fred. Brooks, Boston.
A. F. Brown, Pittsburg.
C. N. Brown, Columbus, O.
C. B. Brush, Newark, N. J.
C. P. E. Burgwyn, Richmond, Va.
J. A. Burgwyn.
M. Burpee, Woodstock, N.B.
Mrs. Burpee.
J. P. Card, Chicago.
C. A. Carpenter, Milwaukee.
W. B. Cogswell, Syracuse, N. Y.
M. Cohen, Baltimore, Md.
C. L. Colby, Milwaukee.
A. D. Conover, Madison, Wis.
C. L. Crandall, Ithaca, N.Y.
Mrs. Crandall.
J. J. R. Croes, New York.
Miss Croes.
J. F. Crowell, Cincinnati, O.
Chas. Davis, Pittsburg, Pa.
Major Chas. E. L. B. Davis, U.S.A., Milwaukee.
Joseph P. Davis, N. Y.
Alex. Dempster, Pittsburg.
J. T. Dodge, Duluth, Minn.
S. B. Downes, New York.
Miss Downes.
N. M. Edwards, Appleton, Wis.
H. N. Elmer, St. Paul, Minn.
R. N. Engle, La Salle, Ill.
J. T. Fanning, Minneapolis.
Mrs. Fanning.
Edw. Flad, St. Louis, Mo.
H. Flad, St. Louis, Mo.
J. B. Francis, Lowell, Mass.
Mrs. Francis.
Alphonse Fteley, N. Y.
Mrs. Fteley, Mrs. Porter.
J. A. Fulton, Wellington, Kan.
C. L. Gates, Toledo, O.
C. E. Goad, Montreal.
Mrs. Goad.
Philip Golay, Vevay, Ind.
Mrs. Golay.
H. Goldmark, Kansas City.
A. Gottlieb, Chicago.
E. B. Guthrie, Buffalo, N. Y.
Mrs. Guthrie.
S. A. Harrison, Milwaukee.
Mrs. and Miss Harrison.
G. F. Haynes, Boston.
E. A. Hermann, Indianapolis.
C. Hermany, Louisville, Ky.
H. J. Hilbert, Milwaukee.
Mrs. Hilbert.
J. W. Hill, Cincinnati, O.
Mrs. Hill.
Olaf Hoff, Minneapolis.
M. L. Holman, St. Louis.
Mrs. Holman.
H. E. Horton, Rochester, Minn.
W. H. Jennings, Columbus, O.
Mrs. Jennings.
J. B. Johnson, St. Louis, Mo.
Mrs. Johnson.
F. W. Kimball, Milwaukee.
K. Kobayashi, Chicago.
O. H. Landreth, Nashville, Tenn.
M. Lassig, Chicago.
Harry H. Latham, Chicago.
Mrs. Latham.
F. D. H. Lawlor, Burlington, Ia.
T. B. Lee. (*Asst. Sec.*) N. Y.
Mrs. Lee.
L. F. Loree, Wellsville, O.
T. D. Lovett, Cincinnati, O.
Miss Lovett.
C. F. Loweth, St. Paul.
Mrs. Loweth.
J. MacLeod, Louisville, Ky.
Miss MacLeod.
G. E. Mann, Buffalo, N. Y.
Mrs. Mann.
Geo. A. Marr, St. Paul.
S. D. Mason, St. Paul.
R. E. McMath, St. Louis.
Miss McMath.
M. Merriman, Bethlehem, Pa.
R. R. Minturn, Milwaukee.
Mrs. Minturn.
Robt. Moore, St. Louis.
G. B. Nicholson, Covington, Ky.
F. G. Nourse, Chicago.
T. W. Orbison, Appleton, Wis.
Mrs. Orbison.
J. O. Osgood, Cleveland.
W. H. Paine, New York.
G. W. Pearsons, Kansas City
G. H. Pegram, New York.
C. J. Poetsch, Milwaukee.
A. Potter, Kansas City.
H. G. Prout, *Railroad Gazette*, New York.
W. W. Rich, Minneapolis.
A. T. Robinson, St. Paul.
Thos. Rodd, Pittsburg.
A. B. Rogers, Waterville, W. T.
L. W. Rundlett, St. Paul.
Mrs. Rundlett.
C. H. Sawyer, Scottville, Kan
Mrs. Sawyer.
J. S. Schaeffer, Newark, N.J.
Mrs. and Miss Schaeffer.
J. W. Schaub, Detroit.
Miss Schaub.
C. C. Schneider, New York.
R. A. Shailer, Chicago.
Mrs. Shailer.
G. H. Simpson, Terre Haute, Ind.
F. W. Skinner, *Engineering and Building Record*, New York.
F. Slataper, Pittsburg.
O. Smith, Bridgeton, N. J.
H. E. Stevens, St. Paul.
C. L. Strobel, Chicago.
E. B. Taylor, Pittsburg.
E. E. Russell Tratman, ENGINEERING NEWS, N. Y.
A. W. Trotter, New York.
Mrs. Trotter.
G. W. Vaughan, Cleveland, O
J. A. L. Waddell, Kansas City.
J. W. Walker, Pittsburg.
J. F. Wallace, Sibley, Mo.
Mrs. Wallace.
J. R. Wardlaw, New York.
Mrs. Wardlaw.
F. C. Weir, Cincinnati.
L. L. Wheeler, Detroit.
O. B. Wheeler, Philadelphia.
S. Whinery, Cincinnati.
T. J. Whitman, St. Louis.
D. J. Whittemore, Milwaukee.
J. M. Wilson, Philadelphia.
G. Y. Wisner, Detroit.

Visitors.

E. G. Aikman, Pittsburg.
I. O. Baker, Champaign, Ill.
C. L. Becker, Sterlingville, N. Y.
C. Carter, Milwaukee.
G. T. Clark, Minneapolis.
W. L. Conkey, Appleton, Wis.
D. C. Cregier, Chicago.
E. J. Duffles, Waukesha, Wis
D. C. Dunlop, Chicago.
Mrs. Dunlop.
W. B. Ewing, Chicago.
J. J. Granville, E. Saginaw, Mich.
R. Gratzell, Hanover, Germany.
J. W. Grimshaw, Sydney, Australia.
J. E. Hathaway, Milwaukee.
W. A. Jefferis, New York.
Mrs. Jefferis.
J. T. W. Jennings, Waukesha, Wis.
F. B. Keene, Milwaukee.
G. Lilienrantz, Chicago.
E. S. Meloy, Milwaukee.
A. Munster, St. Paul.
W. R. Northway, Chicago.
D. Purrington, Chicago.
Mrs. Purrington.
Max Reber, St. Louis.
E. O. Reiter, Milwaukee.
David Rodger, Milwaukee.
W. A. Rogers, Manitowoc, Wis.
O. Sanne, Milwaukee.
F. Schwalbach, Menasha, Wis.
W. B. Sears, E. Saginaw, Mich.
Miss. Sears.
S. E. Longdahl, Milwaukee.
E. M. Spalding, Wis. Cent. R. R.
J. Sullivan, Fishers, N. Y.
H. A. Swenson, St. Paul.
W. R. Tenney, Brunswick, Me.
Job Tuthill, Ionia, Mich.
C. G. Vaughn, Milwaukee.
F. S. Washburn, Chicago.
J. W. Weston, *American Engineer*, Chicago.
W. E. Wood, Milwaukee.

Members	120
Visitors	40
Ladies	47
Total	207

An interesting exhibit at the convention, but one which we omitted to mention last week among the other exhibits, was a chart showing graphically the fluctuations of the water surface and the rainfall from 1859 to 1888, the line of deepest water, greatest depth, areas of water surfaces and basins, discharge and tides of the great lakes. The chart is compiled from official data obtained from the U. S. Lake Survey, the Smithsonian Institute, and the War Department, and was prepared by Chas. CROSMAN, of Milwaukee, Wis.

Association of Railway Telegraph Superintendents.—THE Seventh Annual Convention was held at the Murray Hill Hotel, New York, June 11 and 12. President G. L. LANG, of Boston, representing the New York & New England Ry., presided, and P. W. DREW, of Chicago, of the Chicago & Eastern Illinois Railway, acted as Secretary. The Association numbers about 100 members, representing about 60 railways. Nine new members were elected at this meeting; the officers elected to serve during the ensuing year were: GEORGE C. KINSMAN, of the Wabash, President; CHARLES A. DARLTON, of the Richmond & Danville, Vice-President; P. W. DREW, of the Chicago & Eastern Illinois, Secretary. M. B. LEONARD, Richmond, Va., was appointed Chairman of the Committee on New Appliances, and E. M. HEIR will look after the preparation of papers to be presented at the next Convention.

Various discussions occupied the attention of the Convention, one of the most important subjects considered being standard time and its distribution. Commander BROWN, of the U. S. Naval Observatory, opened the discussion, which was participated in by Messrs. HERR, DARLTON, JONES, SMITH, LENNERD, and others. The committee appointed in 1887 to endeavor to find some substitute for the telegraphic symbol representing "naught" or "zero" reported that nothing better had been found. The objection to the symbol now used is that it is liable to be confused with "T. L."

There was a long discussion on the system in vogue of giving every operator who leaves a road, for any cause whatever, a card stating exactly the reasons why he left. In addition to this the Secretary of the Telegraph Superintendents' Union is notified of the resignation or dismissal of the operator, and he notifies the Telegraph Superintendents of all the other roads. A motion to discontinue the practice was lost. A number of invitations to visit various points of interest in the vicinity were received. It was decided to inspect the new signal system of the West Shore road at the Weehawken tunnel, and the new system of inductive telegraphy in use on the Lehigh Valley, on Friday, June 13. The next Annual Convention will be held at Atlanta, Ga., beginning on the third Wednesday of October, 1889.

The most interesting and important feature of the Convention was the exhibit of the electrical appliances for use in the management of railway trains. The railway telegraph superintendent is the official naturally looked upon as having the most knowledge and familiarity with electricity, and the large increase in the last few years of electrical apparatus for use on railways has added greatly to the duties and responsibilities of this office. The policy of the Association is one calculated to be of very great benefit both to its members and to the roads on which they are employed. They invite everybody to exhibit their appliances at the Annual Conventions, but carefully refrain from endorsing any particular device or system.

Exhibits were made at this convention by the Non-Magnetic Watch Co., the Consolidated Train Telegraph Co., the Union Switch & Signal Co., the Pennsylvania Steel Co., the Railway Cab Electric Signal Co. and several others. The Railway Cab Electric

Signal Co. showed the working of their system by a model, consisting of a section of track, two locomotives, signals, etc.

The Pennsylvania Steel Co. exhibited the Magneto Electric alarm signal for highway crossings, the hand semaphore signal, and a block system, which is the result and, in a measure, a combination of the other two. The distinguishing feature of all these appliances is that the electric current is generated by a dynamo of the magneto type, giving an alternating current and avoiding the use of cup batteries, which need a great deal of attention and are especially liable to get out of order by freezing.

The generator or dynamo consists of from 6 to 12 large permanent steel magnets mounted in a strong frame; between the poles of these magnets a wire wound Siemens armature is made to rotate by passing trains, and thus an alternating current of considerable power is generated. Each wheel which has a tread wider than the rail, depresses a lever placed parallel and close to the rail and projecting above it from $\frac{1}{8}$ in. to $\frac{1}{4}$ in. The motion of the lever compresses two spiral springs, and when the wheel has passed off the lever, these springs are released and, by means of a ratchet wheel an impulse is given to the armature shaft. This ratchet was designed especially for this machine, the motion being transmitted by a perfectly positive clutch for forward motion, and backward motion being accompanied by no noise and very little friction. A fly wheel gives steadiness and continuity to the motion derived from the impulses given by the passing car wheels. A water-tight iron box 16 ins. square and 13 ins. high encloses the mechanism, and is placed far enough from the track to be out of the way of snow plows etc. The armature shaft connects with the steel lever beside the rail. The same kind of dynamo is used for the highway alarm and the block system, and one of similar design, but operated by turning a crank, for the hand semaphore. There are no brushes or commutators to get out of order, and no batteries requiring renewal.

The current thus generated can be transmitted any moderate distance, say up to 6 or 8 miles, and there used to sound an alarm gong or operate a semaphore. A vibrating armature permits the use of the alternating current, which is one of the distinguishing peculiarities of this system. The motor and a semaphore or alarm gong are mounted on a post 16 to 20 ft. high.

The equipment for a crossing consists of two dynamos, usually placed from 1,500 to 1,800 ft. from the crossing, and two posts, two motors and two bells, the whole costing less than $300. For use on single track roads a second lever is placed beside the rail, nearer the crossing than the first one, so that when a train is moving *from* the crossing this lever will be depressed first, a switch turned, and no alarm sounded. The passage of a single wheel is sufficient to start the alarm, and after the passage of a train it continues to ring for some time, generally until the train reaches the crossing.

In the block system the passage of a train throws up the danger signal at that point, and immediately afterward throws down the danger signal at the preceding station, which may be several miles back. Thus, in no case can two trains get upon the same section, if the signals are observed; for the warning cannot be removed at the beginning of one section until the train has passed on to the next one. One dynamo, and one motor and semaphore will be required for each section. The cost will depend upon the length of section adopted. The semaphores can be so adjusted that an enormous force would be required to change their position by other means than that intended. This system has just been brought before the public, and is not yet in operation.

CONSTRUCTION NEWS.

RAILROADS.

East of Chicago.

Existing Roads.

Niagara Central.—This line was formally opened for traffic between Niagara Falls and St. Catharines, Ontario, on July 11. At the celebration over the opening President OILLE stated that the directors intended to begin work at once on the western division of the road. The line is projected to extend from Niagara Falls to Toronto.

Portland & Ogdensburg.—The directors of this company, whose line extends from Portland, Me., through the White Mountains to the western boundary of New Hampshire, have arranged to lease it to the Maine Central, which company assumes the bonded indebtedness and agrees to pay a dividend on the stock of one per cent. for three years, and two per cent. thereafter. The lease has been ratified by the directors of both companies, but requires the ratification by a popular vote of the city of Portland, which holds the controlling interest in the Portland & Ogdensburg company.

Maine Central.—The branch from Enfield, on the Vanceboro division, to Piscataquis Falls, is nearly completed. The contractors for its construction were C. H. & R. W. Sawyer. It is about 34½ miles in length.

Philadelphia & Reading.—Much interest is excited over the report that this company intends to establish a new through trunk line to Chicago. The route, as outlined, is *via* the Reading main line to Williamsport, Pa., thence over the Fall Brook Coal company's line to Corning, N.Y., thence *via* the New York, Lake Erie & Western to Buffalo, and thence over the Nickel Plate to Chicago. The same, or a similar route, is proposed for passenger travel. It must be questioned, however, whether so roundabout a road would be a competitor which the present trunk lines would greatly fear.——The company are to build repair shops and a round house, at Sunbury, Pa., and a branch is projected from that point to Selin's Grove.

Canadian Pacific.—On the extension of the International railway in Maine a contract has been let to Jos. MITCHELL, of the contracting firm of Spofford & Mitchell, to ballast 70 miles of the line.

South Pennsylvania.—The present prospect seems to be that work on this line will not be resumed before fall. It is reported that THOS. M. KING, late Vice-President of the Baltimore & Ohio, is likely to be chosen as President and General Manager.

Port Jervis, Monticello & New York.—Much interest has been excited by the recent difficulty between this company and the New York, Lake Erie & Western. The Port Jervis road has been a valuable feeder of the Erie and has been wholly dependent on it for outside connections. A year ago President Low began the construction to gain a connection with the New York, Ontario & Western, of a line 17 miles in length from Huguenot to Summitville, and an extension of the main line has also recently been started from Monticello north to Liberty Falls where a second connection is made with the Ontario road. Lately it is claimed that the Erie officials have tried to put a stop to the attempt of the Port Jervis road to secure an independent outlet. They offered to purchase the line with all its franchises, and when this offer was refused, inaugurated a boycott policy and shut off the company from its use of the Erie terminal facilities at Port Jervis and from all interchange of freight. Nevertheless the company is persisting in its refusal to sell out, and is pushing work on its connection with the New York, Ontario & Western.

New York, Mahoning & Western.—For a company which has for a president the executive head of the Western Union Telegraph Co., the New York, Mahoning & Western Railway seems to be built through a great deal of financial hot water. The money was no sooner raked together to pay for the rails which the North Chicago Rolling Mill Co. held a mechanics' lien on, than the grading and tracklaying contractors began to clamor for their pay and finally stopped work. The company is making every effort to complete its line from Ottawa to Findlay, O., where a subsidy of $85,000 awaits it.

Cincinnati, Hamilton & Dayton.—The latest development in this most complicated of railway tangles is the finding by the Grand Jury of Cincinnati, of indictments against HENRY S. IVES, "the Young Napoleon of Finance," and GEO. STAYNER. But when the officers of the law came to New York City to arrest the above named gentlemen it transpired that they had gone to Canada on a fishing excursion and "nobody knew when they would get home."

New York, Ontario & Western.—Work has begun on the tunnel between Walton and Sidney Centre, New York.

Wheeling & Lake Erie.—This company and the South Pennsylvania & Ohio are running a race to secure the most favorable line from Bowerstown, O., to Wheeling, W. Va., a distance of 40 miles. Both companies have grading forces in the field and are pushing work. It is stated, however, that the South Pennsylvania & Ohio is outstripping its rival and has secured the control of most of the important passes through the hills.

Pennsylvania.—Surveyors are reported at work on a line from Niles, 9 miles west of Youngstown, O., to Ravenna on the Cleveland & Pittsburg Railroad. This line, if built, would give the Pennsylvania a competing line to the New York, Pennsylvania & Ohio from Cleveland to Youngstown. It is again reported that work is soon to begin on a short line from Indianapolis, Ind., to Anoka Je. The line if built would be an important competitor of the Louisville, New Albany & Chicago.

Staten Island Rapid Transit.—Condemnation proceedings are in progress for securing right of way for the extension of this line from Erastina to the Arthur Kill bridge.

Albert.—At a meeting of the bond holders of this New Brunswick railway in London, England, it was decided to take all necessary steps to secure control of this railway and operate it for the bond holders' benefit.

Baltimore & Harrisburg.—Work is to begin soon on the extension from Ortuana to Blue Ridge summit, near Gettysburg Pa., a distance of 15 miles.

Cleveland & Western.—A press dispatch from Delphos, O., says: "Work is progressing rapidly on the extension of the Cleveland & Western Railroad. W. C. MOBLEY, the general manager, has made his headquarters at Carey, and directs all movements from that point."

Turtle Creek Valley.—This company which is building a railway from Stewart's Station to Saltsburgh, Pa., to connect the Murraysville gas district with the Baltimore & Ohio & Pittsburg, McKeesport & Youghiogheny roads is having litigation with the Pennsylvania over the right of way.

Meriden & Waterbury.—The citizens of Middletown, Ct., are working to secure a branch of this line to their city and it is thought that the branch will be built.

New Projects and Surveys.

Sandusky, Ashland & Coshocton.—At a meeting of the directors of this company on July 14, it was voted to cancel the original mortgage on the company's proposed line and create a new one for $6,000,000. It was also voted to remove the general offices of the company from Ashland to Sandusky.

Auburn.—The construction of a narrow gauge railway from Auburn to East Auburn, Me., has been authorized by the State Railway Commissioners. F. W. DANA of Auburn is President of the company.

Pittsburgh, Cannonsburg & State Line.—This company has been organized at Cannonsburgh, Pa., to build a railway from Pittsburgh up Chartiers creek to Cannonsburgh, connecting at the State line with the Wheeling, Wellsburg & State Line railway, on which surveys have been in progress for some months.

Baltimore & Eastern Shore.—It is reported that this Maryland company are soon to begin work on the construction of their line. They have secured control of the Wicomico & Pocomoke roads. Jos. B. SETH, of Easton, Md., is President.

SOUTHERN

Existing Roads.

Cumberland Valley.—The route for the Martinsburgh & Potomac extension to Winchester, Va., has been decided on and work is to begin soon. The line is 21 miles in length and runs through a fertile and well populated region. CHAUNCEY IVES of Chambersburg, Pa., Chief Engineer of the Cumberland Valley Railroad, is in charge of the extension.

Ohio Valley.—The report that the company was to sell a portion of their line from Marion to Princeton, Ky., and build an extension from Marion to Paducah, is denied; as is also the rumor that the company is to be consolidated with the Louisville, St. Louis & Texas. Surveys are in progress for the extension into Evansville, Ind., and it is to be completed in 90 days. Engineers are also at work on the extension south from Princeton and grading on that division is to begin soon. The citizens of Hopkinsville, Ky., are greatly incensed because the company has informed them that the $100,000 subsidy which was originally asked to secure the extension *via* that point will not be sufficient, and that another hundred thousand must be raised if the extension is desired.

Carolina, Cumberland Gap & Chicago.—About half the track is laid on the division between Aiken and Edgefield, S. C., 20 miles, and the work on the remaining 10 miles is in rapid progress. The Charleston Chamber of Commerce are having good success in their attempt to raise $1,500 to pay for a re-survey of the line between Pickens, S. C., and Asheville, N. C.

Maysville & Big Sandy.—This line was opened for business from Maysville to Ashland, Ky., on July 16, a distance of 82 miles. Tracklaying is making rapid progress toward Cincinnati, and the train service will soon be extended to Ripley, Augusta and other towns along the line. H. E. HUNTINGTON is Superintendent of Construction.

Tennessee Midland.—Some enterprising story teller started the report that JAY GOULD had bought the Tennessee Midland and caused much excitement in the railroad circles of Memphis and Nashville until the rumor was proved to be without foundation.——Work is in progress from Jackson toward Nashville, and a corps of surveyors are locating the entrance to Nashville.

Ohio River.—Chief Engineer FICKINGER is with a party making the locating surveys for the extension from Spencer to Ravenswood, W. Va.

Natchez, Jackson & Columbus.—The city of Natchez, Miss., will vote on Aug. 7 upon the proposition to grant this company a bonus of $25,000, contingent upon the company's changing its line from Natchez to Jackson to standard gauge and establishing shops at Natchez.

Richmond & Chesapeake.—The contract for constructing the tunnel at Richmond, Va., has been sublet to J. C. Carpenter & Co.

Nashville & Knoxville.—Grading is completed on this Tennessee line from Lebanon to Carthage. The tracklayers have reached Gordonville but will not be at Carthage before Aug. 1.

Kansas City, Memphis & Birmingham.—The $55,000 subsidy in aid of the extension from Aberdeen to Columbus, Miss., 28 miles, was voted almost unanimously by that city on July 12. Work on the line will begin soon. A branch line at Jasper, Ala., two miles in length, has just been located.

Montgomery & Florida.—This Alabama road was sold at foreclosure sale on July 12 and was bought by DAVID S. BOODY of Philadelphia, representing the bondholders. The company will be reorganized and the road will be extended to Lawrence at once. Gen. STUART L.

WOODFORD will remain in control of the property for the present.

Richmond & Danville.—Arrangements for the new terminals at Norfolk, Va., are making rapid progress. The reorganization of the Chowan & Southern Railroad Company has been effected, GEO. S. SCOTT, of the Richmond & Danville being elected President. The $45,000 purchase money has been paid for the land on which the terminals are to be erected. G. M. SERPELL, the former President of the Chowan & Southern, has been appointed Chief Engineer and General Manager, and the contract for improving the terminals and placing in good order the Chowan & Southern has been let to the American Construction Company.——The report gains much credence that the managers of three systems, the Richmond & West Point Terminal, the Central R. R. of Georgia, and the Atlantic Coast Line have perfected an alliance looking to a harmonious division of traffic, avoidance of discrimination, rebates and expenses due to drumming up shipments, and the avoidance and discontinuance of the construction of parallel competing lines. The credit for conceiving and bringing about this most desirable end is given to that level headed financier, Mr. JOHN H. INMAN.

Columbia, Newberry & Laurens.—At the annual meeting, held at Columbia, S. C. July 10, the old board of directors was re-elected. H. C. MOSELY was elected President; CHAS. ELLIS, Jr., Chief Engineer, and C. C. WILSON First Assistant Engineer.

Cincinnati & Green River.—GEO. B. HARPER has been appointed Receiver of this Kentucky road.

Chesapake, Ohio & Southwestern.—The first preliminary survey of the extension from Paducah to Cairo has been completed and one or two other lines are to be run.

Richmond & Allegheny.—The consolidation of this company with the Chesapeake & Ohio has now been definitely arranged. Operations under the lease will begin in the fall. A majority of the bondholders of both companies are said to have expressed themselves in favor of the plan. The Richmond & Allegheny will probably issue $5,000,000 of new bonds which the Chesapeake & Ohio will guarantee.

Pensacola & Memphis.—This company is endeavoring to secure a subsidy from Enterprise, Miss.

Humboldt & Dyersburgh.—Messrs. Ferguson & Yates, who have just completed the Troy and Tiptonville Railroad from Rives to Troy, Tenn., are pushing this projected line at Jackson and hope to secure local aid enough to ensure the building of the line.

New Projects and Surveys.

Cashie & Roanoke.—This company proposes building a short road near Avoca, N. C.

Louisville, Cincinnati & Virginia.—A correspondent writes for information of the "Virginia, Kentucky & Chicago Railroad, of which J. C. TURNER of Winchester, Ky., is Chief Engineer." We suppose his reference must be to the above company which was incorporated and did some work on surveys and perhaps on construction a year ago. Since then little has been heard from the project and if our correspondent wishes to look it up he may address the President, J. L. ROBERTSON, No. 7 Nassau St., New York City, or J. C. TURNER of Winchester, Ky., Chief Engineer, who made the last report to us.

Leesburg, Lisbon & Palatka.—This company has organized in Florida to build a railroad from Leesburg to Lisbon and thence *via* Grahamville to Palatka, J. S. HOOPER, WM. D. MENDENHALL, A. J. CASSIDY and others, of Leesburg are among the incorporaters.

Missouri, Tennessee & Alabama.—Incorporated in Tenessee "for the purpose of constructing a railway from some point in the State of Missouri, or Arkansas, connecting with the Kansas City, Memphis & Birmingham Railroad *via* Dyersburg in Dyer County, Alamo in Crockett County and Jackson in Madison County, Tenn., to some point in Alabama, either Florence, Decatur or Birmingham". Among the incorporators are THOS. W. NEAL, J. E. RICHARDSON, JOHN M. NICHOLS and R. W. FLEMING.

Hawkinsville, Americus & Eastman.—This is the name of the company which proposes to build from Hawkinsville, Ga., to the Georgia Southern & Florida Railroad, as reported last week. Among the citizens of Hawkinsville who are interested are R. J. TAYLOR, R. G. LEWIS, R. V. BOWEN, J. D. STETSON and J. O. JELKS.

South Bound.—President JOHN L. HAMMOND of Savannah has placed the preliminary surveys for this line, frnm Columbia, S. C.. to Savannah, Ga., in charge of THOS B. LEE.

Alexandria & Charleston.—This line is projected from Alexandria, Va., to Charleston, W. Va., about 300 miles. JOHN S. BARBOUR, of Alexandria, is President.

Uniontown, Newberne & Dayton.—Over $42,000 of stock has been subscribed to this Alabama company. The assessment necessary to pay for the surveys has been raised and engineers are now running the line.

Morgantown.—P. H. MCMICHAEL, of Louisville, Ky., has made a preliminary survey for a railroad from Morgantown, Ky., to Mud River Mines to connect with the branch of the Owensboro & Nashville. The distance is about 20 miles, and it is thought that Morgantown and Butler county can raise funds sufficient to pay half the expense of grading.

Perry.—A meeting was recently held at Perry, Ga., to discuss the possibility of building a railway from that point to a connection with the Georgia Southern & Florida. A committee was appointed to confer with officers of the Georgia Southern & Florida and the Central of Georgia companies, and to find out the probable cost of the proposed line. J. D. MARTIN and W. D. NOTTINGHAM were members of the committee

Memphis, Oxford & Columbus.—Chief Engineer BELTON MICKLE has just completed a preliminary survey of the route from Tuskaloosa, Ala., to Columbus, Miss., and will run a second line *via* Carrollton.

Nashville Marginal.—This company has applied for a franchise from the City Council of Nashville, Tenn., proposing to construct a belt and freight transfer railway about that city.

THE NORTHWEST.

Existing Roads.

Duluth, South Shore and Atlantic.—It is officially announced that parties closely connected with the Canadian Pacific Company have purchased a controlling interest in this line. The deal was arranged principally by Messrs. SAMUEL THOMAS and CALVIN S. BRICE who have been prominently connected with the enterprise from its inception.

Atchison, Topeka & Santa Fé.—Omaha has been greatly interested over a rumor that the Santa Fé company intends to build an extension to St. Paul, Minn., *via* Omaha and Yankton, Dak. This is not the first time that rumor has built a Nebraska extension to the Santa Fé system; but thus far the prospect of graders following the example of the rumor makers seems quite remote.

Sioux City and Northern.—A press dispatch from Sioux Falls, Dak., says:

"The contract entered into by the Manitoba and the Sioux City and Northern Railway Companies for the former to operate the latter company's line from Palisades to Sioux City upon its completion has been declared off. Since the decision of the Iowa Railroad Commissioners, the New York capitalists who agreed to place the bonds of the Sioux City and Northern have rescinded their contract, and the Manitoba company also declined positively to have anything to do with any Iowa branch. This insures this city the main line of the Willmar and Sioux Falls beyond any question. It is also stated upon good authority that the Illinois Central will extend its lines from Sioux Falls to Mitchell this season in order to be ready to cross the border into the Sioux Indian Reservation upon its opening."

Illinois Central.—Much was expected by Dakota from the recent visit of Illinois Central officials to Sioux Falls. The press reports give the following as President FISH'S oracular reply to the question whether his road would build further extensions in Dakota:

"A railroad never ceases to extend till it strikes salt water. The Illinois Central will consider the extension, and if the Dakota legislature does not pass laws detrimental to railroad projects the prospects are fair for the laying of many miles of iron in Dakota next year."

Minneapolis, St. Paul & Sault Ste. Marie.—The citizens of Bismarck, Dak., are becoming tired of waiting for the completion of the Aberdeen, Bismarck & Northwestern, which was graded to that town last year, and have sent a committee to Minneapolis to find why the rails are not laid and also to induce the other Northwestern systems to "hurry up" with their extensions to Bismarck.

Winnipeg & Hudson Bay.—ANDREW ONDERDONK and NICOL KINGSMILL are in Winnipeg negotiating with the Government for the building of this road. They state that if the Government will stand by its promise to guarantee $4,500,000 on the company's bonds, the road will be built at once.

Northern Pacific—Negotiations are still in progress between members of the Manitoba Cabinet and Mr. MCNAUGHTON, the representative of the Northern Pacific. The contract, which is not yet closed, provides that the Northern Pacific is to purchase the Red River Valley Road, which the Government agrees to complete to Winnipeg, the figure being about $1,600,000. The Northern Pacific agrees to build to the Portage this Fall, and to push the Brandon connection as far as possible before the frost sets in, to complete the Brandon connection early next Summer, and also to construct a system of branch lines in all important directions when the trade will warrant the work being done. It agrees to construct a number of elevators at important points, and to spend large sums of money in this and other ways.
The Manitoba Central Company is to be set aside, and the Northern Pacific will utilize the two miles of grade built last week for its line to Portage La Prairie. It is understood the Government is going to agree to aid the Portage link and other extensions to the amount of $5,000 per mile by issuing provincial bonds.

It is stated that the Government has no intention of maintaining the Red River Road as an independent roadway, but will make a complete transfer to the Northern Pacific, requiring only from the company a guarantee of a certain maximum rate on wheat and certain other lines from the province to Duluth, where advantage can be taken of keen competition in lake freights. This point is liable to provoke some indignation at Winnipeg, as it is understood to have been the policy of the Government to maintain the Red River Valley Road as an independent line. The statement that harmonious arrangements had been made between the Northern Pacific and Canadian Pacific for maintaining rates and the purchase of the Duluth, South Shore and Atlantic Road by the Canadian Pacific leads people to believe that the Manitobans will not be much better off with the two roads than with the Canadian Pacific Road alone.

Illinois Central.—On the Chicago, Madison & Northern extension, track is all laid between Freeport, Ill., and Elmhurst. Ballasting is in progress and trains will be running by Aug. 1. Grading on the division from Elmhurst east is about completed, and 3½ miles of track are laid.

New Projects and Surveys.

Cairo & Northwestern.—MARTIN BROWN is making a preliminary survey of this Illinois line which is to run from Cairo to East Cape Girardeau, 45 miles. H. WELLS, of Cairo is Secretary of the company.

Grand Forks & Dakota Southern.—GEO. A. EASTMAN, of Grand Forks, Dak., has filed deeds for right of way for this road through Grand Forks, Trail and Cass counties, in Dakota.

Manitoba.—The London *Financial News* comments thus on Manitoba railway projects:

"The Ontario, Manitoba & Western is an ambitious project. It asks for $10,000,000 of share capital, and while its length, including main line and branches, is intended to reach apparently 750 miles, at no point is it more than a few miles distant from either the Canadian Pacific or one of its branches, and nowhere does it even colorably serve a new district. The Great Northwest Central appears equally guiltless of *raison d'etre*. Its point of departure is Brandon, from whence it proposes to run westerly between the main lines of the Canadian Pacific and the Manitoba and Northwestern, passing for some hundreds of miles within from ten to twenty miles of one or other of these railways. We have as yet heard of no definite purpose to place capital for either of these lines in this market; but we need no prophet to tell us that in one shape or other the attempt will be made. Home investors will do well to recognize the undesirability of building railways of this class so far in advance of the country's requirements, and to button their pockets accordingly."

——The House of Representatives has passed bills granting right of way through Indian reservations to the following railway companies: Through the Fond-du-Lac, Minn., reservation to the Duluth & Winnipeg Co. Through the Yankton, Dak., reservation to the Yankton & Missouri River Co. Through Indian lands in Minnesota to the Moorhead, Leech Lake & Northern Co. Through the Sioux reservation, Dak., to the Aberdeen, Bismarck & Northwestern Co.

THE SOUTHWEST.

Existing Roads.

San Antonio & Aransas Pass.—The branch nine miles in length to Rockport is now in operation.——Work is delayed on the Houston extension by sickness in the grading camps. The prairies are covered with water and malaria is prevalent.——The most important extension which is now in prospect on the system is the line to Brownsville, Tex. President LOTT has offered to build it for free right of way and depot grounds in Brownsville and a bonus of $150,000, at least half of which shall be in cash, the road to be completed to Brownsville in two years. The extension to Giddings has also been arranged for.

Missouri Pacific.—Trains are now running over the Lexington, Boonville & Jefferson City extension to Boonville, Mo. There are renewed rumors of a bridge across the Missouri at Lexington.——Holders of Mo. Pac. stock are interested in the report that GOULD has quietly unloaded about $15,000,000 in the past few months.——The switching charges at St. Louis have been advanced from two to four dollars per car by the Missouri Pacific officials, a sudden jump which has made a most unfavorable impression on the Burlington and Wabash companies, who are obliged to use the GOULD terminals.

Austin & Northwestern.—This Texas company has a corps of surveyors in the field running a line from Burnet to Llano. H. L. HIGDON is in charge of the party.

Chicago, St. Paul & Kansas City.—This company has brought suit to secure a trackage right over the Kansas City, St. Joseph & Council Bluffs Ry. for an entrance to St. Joseph. The City of St. Joseph when right of way was granted to the St. Joseph & Council Bluffs road, inserted a proviso that all roads entering the city from the north should have right of way over the St. J. & C. B. tracks. The company resists this on the technical ground that the proviso applied only to the original company, and was made void when that company was merged in the present one. It seems hardly likely that this technicality will be allowed to obstruct the fulfillment of the city's original intention.——Grading is expected to begin soon on the extension from St. Joseph to Leavenworth, Kan.

Kansas City, Fort Scott & Memphis.—President NETTLETON is quoted in reference to the Memphis bridge as follows:

"I am very well satisfied with the decision of Secretary ENDICOTT on the Memphis bridge, and our engineers will go to work at once and estimate the cost. We were in favor of a 700 ft. channel span, and the Secretary thinks 730 ft. would be about the proper thing. I think his argument in regard to a span 1,000 ft. long was very good, and it seems to me there is more danger in allowing

barges 1,200 ft. in length to become unmanageable than there is in a bridge with a span 700 ft. long. If the estimates prove all right we will begin work on the bridge this fall."

Kansas City & Pacific—The northern extension of this Kansas road will reach Paola, about Aug. 1. It is probable that an entrance to Kansas City will be made from that point over the track of some existing road. It is stated that the southern extension across Indian Territory is soon to be pushed.

New Projects and Surveys.

Kansas City & Sabine Pass.—Engineers are in the field cross-sectioning the located line, and it is announced that contracts have been let by General Manager WM. ANDERSON for the division from Pierce City to Lamar, Mo., 41 miles.

Denison & Washita.—W. B. MUNSON, the projector of this Texas road, is negotiating for the sale of its franchise and the six miles of completed line to a Minneapolis syndicate represented by A. M. ALLEN.

New Orleans & Northwestern.—The project for a railroad from Ruston to Columbia, La., referred to some weeks ago, has resulted in the formation of a company with the above title with the following officers: President L. M. KIDD, of Ruston; Vice President, J. H. GRAMBLIN; Treasurer, W. F. ASHLEY; Secretary, J. A. PARKER. The proposed line will be narrow gauge.

Nevada & Eldorado.—The project for a railroad between these Missouri towns, which was agitated a year ago, is being revived. Nevada is trying to raise $50,000 in aid of the project.

Kansas City, Lawrence & Nebraska.—General Manager D. W. WEBSTER, of Lawrence, Kan., is trying to raise funds in the East for this line, surveys for which were made last season by BREITHAUPT & ALLEN of Kansas City.

Camden & Northwestern.—Surveys are in progress on this Arkansas road, incorporated nearly a year ago. The line is to run from Camden to the coal mines at Lester. RICHMOND HIBBARD of Camden is interested.

—The House of Representatives has passed bills granting right of way through the Indian Territory to the following railway companies: the Ft. Smith, Paris & Dardanelle Co., the Leavenworth & Rio Grande Co., the Montana, Kansas & Texas Co., and the St. Louis & San Francisco Co.

ROCKY MOUNTAIN & PACIFIC.

Existing Roads.

Montana Central.—The first train over the extension to Butte, Montana, reached that city on July 11. President BROADWATER and other officials of the company joined in the celebration at Butte over the road's completion. The St. Paul, Minneapolis & Manitoba system has now a continuous line from St. Paul, Minn., to Butte City, Montana, 1,243 miles in length.

San Francisco, Clear Lake & Humboldt.—President W. H. H. HART has returned to San Francisco from the East, and states that work will not be resumed on the road for two or three months at any rate. Even then, if the subsidies are not renewed and six months allowance of time be given, the prospects for the construction of the road are most dubious.

Oregon Ry. & Nav. Co.—The contract for building the Washington & Idaho extension has been let to Kilpatrick Bros. & Collins of Beatrice, Neb. This extension will give the company access to the Cœur d'Alene mining camps.—The new iron bridge over the Willamette river at Portland, Ore., was opened to traffic on July 10.

Northern Pacific.—Surveyors are at work between Wardner, Idaho and Cœur d'Alene City on the extension reported last week.

Park & Cliff House.—This short suburban road at San Francisco is completed and is now open for traffic.

Chicago, Kansas & Nebraska.—Articles of incorporation have been filed in Colorado consolidating with this company the recently chartered Chicago, Rock Island & Colorado company, being the lines of the Rock Island system in Colorado.

Mexican Pacific.—This new company has purchased the old Sinaloa & Durango railway and surveys are to begin at once on the proposed extension. Among those interested in the company are Col. EDMOND GREEN of San Francisco and WM. H. MCWOOD of Mazatlan, Mexico. E. L. WARNER is Chief Engineer.

Mexican National.—The recent heavy floods did serious damage to the partially completed grade of this line, and several bridges were swept away.—The line is now completed to within 40 miles of San Luis Potosi. Over 4,000 hands are at work on the uncompleted section. —The new iron bridge across the Rio Grande, at Laredo, will be finished sometime in September.—W. L. CLARK is now Superintendent of the Northern General division.—The Colima branch, of which about 28 miles were built and put in operation seven years ago, is to be continued from its terminus at Armenia to the city of Colima, a distance of 32 miles. The surveys for the extension are under the direction of H. H. FILLEY. It is thought possible that this line will eventually be pushed on to Guadalajara to connect with the Mexican Central branch.

Mexican Interoceanic.—A report is current at Vera Cruz that this company is to be consolidated with the Mexican company.

Colorado Midland.—Bridges and culverts are being put in on the extension from Glenwood Springs to Newcastle, and the rails will soon be laid. The line was graded last season.

Northern California.—Grading is in progress on the extension from Marysville to Knights Landing.

Portland & Vancouver.—The construction of this short line, extending from Portland, Ore., across the Columbia river bottoms to a ferry connection with the city of Vancouver on the north bank of the Columbia, is making rapid progress. Grading is to be completed by Aug. 10 and it is hoped to have the line open for business by Sept. 1.

New Projects and Surveys.

Portland & Mt. Hood.—Organized at Portland, Ore., to build a railway from that city to the snow line on Mt. Hood, a distance of about 70 miles.

Port Townsend Southern.—Preliminary surveys were started on this line at Port Townsend, W. T., on July 10, under direction of R. E. ANDREWS, of Seattle, Chief Engineer.

Port Townsend Bay & Columbia River.—This company has filed articles of incorporation in Washington Territory and proposes to build a railway line from Port Townsend, W. T., through Jefferson, Mason, Chehalis, Thurston, Lewis, Cowlitz and Clark counties to the Columbia river. The incorporators are H. L. TIBBALS, Jr., MELVILLE M. BUCKMAN, and CHAS. A. DYER of Port Townsend, and DAVID WALLACE of Seattle.

—The House of Representatives has passed bills granting right of way through Indian reservations to the following railway companies: Through the Wind river reservation in Wyoming to the Wyoming Midland Co. Through the Nez Percé reservation, Idaho, to the Oregon Ry. & Nav. Co. Through the Puyallup Valley reservation, Washington Territory, to the Puyallup Valley Co. Through the Silent reservation, Ore., to the Newport & King's Valley Co.

Proposals Open.

Steel.—Plates, beams, rivets, castings, etc. JAMES FULTON, Paymaster General, U. S. N., Navy Department Washington, D. C. July 23, 24.

Bridges.—Two iron bridges; 180 and 80 ft. long, the latter with 18 ft. roadway; a 5 ft. sidewalk on each side. THE COUNTY COMMISSIONERS, Hollidaysburg, Blair Co., Pa. July 25.

Dam and Reservoir.—Distributing reservoir dam and appurtenances. Plans and specifications at the office of the Naugatuck Water Co., in the Town Hall. Engineer, T. H. MCKENZIE. S. S. SCOTT, Secretary, Naugatuck Water Co., Naugatuck, Conn. July 25.

Sewer Work, Earth Work, Etc.—Sewers, excavation, bridge flooring, elevators, etc. DEPARTMENT OF PUBLIC PARKS, 49-51 Chambers St., New York City. July 25.

Sewers.—THE COMMISSIONER OF PUBLIC WORKS, 31 Chambers St., New York City. July 26.

Sewers.—Brick and stone sewer; about 14,038 ft. of 2½ ft. to 8 ft. diameter. E. M. BIGELOW, Chief of Dept. of Public Works, Pittsburg, Pa. July 27.

Pipe and Flexible Joints.—About 3,425 ft. of 6-in. cast-iron pipe; between Long and Moon islands, Boston harbor. THE WATER BOARD, Boston, Mass. July 27.

Bridge.—Iron bridge, 100 ft. long, 12 ft. roadway, 4 ft. sidewalk. To be let July 28, on the ground, at California, Pa. DAVID E. MCNARY, Commissioner, West Middletown, Washington Co., Pa.

Water Tower, Etc.—Water tower with stone foundations; wrought-iron pier 75 ft. high; wooden tank 20 x 30 ft. Engineers, LOWETH & CURTIS, St. Paul, Minn. J. H. JEFFERS, Chairman, Water-Works Committee, Cedar Falls, Ia. July 31.

Water-Works.—Plans and specifications on file. GEO. R. FAIRBANKS, Chairman, Board of Public Works, Fernandina, Fla. Aug. 1.

Water-Works.—Supply well, building and chimney, pumping machinery and boilers; 8 or 10-in. rising main, 9,600 ft. long; storage reservoir, capacity 1,250,000 galls.; 12-in. supply main to city, 10,000 ft. long; 1,520 ft. of 12-in. pipe, 600 ft. of 10-in., 2,761 ft. of 8-in., 9,520 ft. of 6-in. and 5,420 ft. of 4-in.; one 10-in. valve, four 8-in., sixteen 6-in., fifteen 4-in.; 35 fire hydrants; also pipe-laying and everything necessary to a complete system of water-works. Pumping machinery (horizontal or vertical) with capacity to pump 750,000, 1,000,000 and 1,500,000 galls. per day into the reservoir, the flow-line of which will be 410 ft. above the low water surface of Rolling Fork river, the source of supply. Engineer, J. D. COOK, Toledo, O. A. OFFUTT, Chairman, Water-Works Directors, Lebanon, Ky. Aug. 1.

Water-Works.—Plans and specifications prepared by GEO. C. MORGAN, of Chicago. A. J. GENNILE, City Clerk, St. Ignace, Mich. Aug. 1.

Bridges.—Two bridges, iron preferred; 150 ft. and 94 ft. center to center of abutments; roadway 16 ft. clear, substructure and superstructure. THE COUNTY COMMISSIONERS, Shelbyville, Shelby Co., Ind. Aug. 3.

Water-Works.—Complete system. Engineer, CHESTER B. DAVIS, Chicago, Ill. THE WATER COMMISSIONERS, Mt. Clemens, Mich. Aug. 3.

Sewer Pipe and Sewers.—About 3,419 ft. of trenching and pipe laying, 12 manholes; 1,846 ft. of 12-in. vitrified sewer pipe, 1,480 ft. of 10-in., 93 ft. of 8-in., 100 ft. of 10 and 12-in. half pipe, 140 4-in. Y's. C. F. SINGLETARY, Clerk, Board of County Supervisors, San Jose, Santa Clara Co., Cal. Aug. 6.

Sewers and Street Work.—Pipe sewer; excavation, filling, curbing, cobblestone paving; plank walks, etc. THOS. J. LANAHAN, Clerk, Board of Contract, Albany, N. Y. Aug. 6.

Lock.—Coffer-dam, lock pit and Lock No. 1, Cumberland river, near Nashville. Lt. Col. J. W. BARLOW, U. S. Engineer Office, Chattanooga, Tenn. Aug. 7.

Plans for Sewerage System.—Complete system. W. B. DENNETT, City Clerk, Fresno, Cal. Aug. 20.

Contracting.

Plant Wanted.—Chas. H. Goodenough and G. B. Shepard, of Clermont, Fla., wish to purchase a well-boring plant.

S. G. Culpepper, of Boston, Ga., wants to purchase 5 miles of second hand 35 lb. steel rails, one light standard gauge locomotive, and 5 logging cars.

Water-Works.—The following contracts have been awarded by the Water Commissioners, Sing Sing, N. Y.: Pumping station, Genung, Ryder & Co., Sing Sing, $9,145, not including timber in foundations; pipes and specials, Gloucester Iron Works, Philadelphia, Pa., $38,261.08; hydrants and valves, R. D. Wood & Co., Philadelphia, $4,244.65; pipe laying, Fogg & Scribner, New York: $20,425.94; Indian Brook reservoir and intermediate service reservoir, Ward & Leary, Jersey City, N. J., $23,148.85 and $14,641.80; high service reservoir, Genung, Ryder & Co., Sing Sing, $3,576.80. The contract for pumps and boilers was not awarded. The work included is as follows: one compound condensing pumping engine and boilers, 2,000,000 galls. daily capacity; brick pumping station; 5,380 ft. of 16-in. cast-iron pipe, 14,400 ft. of 12-in., 3,530 ft. of 10-in., 7,534 ft. of 8-in., 13,462 ft. of 6-in., 16,624 ft. of 4-in.; 37 net tons of special castings; 90 double nozzle hydrants; 65 street valve boxes; trenching and laying about 60,940 ft. of pipe and setting valves, hydrants and specials; one impounding reservoir, one distributing reservoir and one high service reservoir. S. M. SHERWOOD is Secretary of the Water Commissioners.

For this work, which was advertised in ENGINEERING NEWS, there were 50 bidders, and the numbers for the different sections was as follows: pumps and boilers 16 bidders; pumping station, 5; pipes and specials, 12; hydrants and valves, 18; pipe laying, 22; impounding, distributing and high service reservoirs, 15, 14 and 13 respectively.

Pumping Machinery.—***Springfield, O.***—The following were the bids for pumping machinery with a daily capacity of 5,000,000 galls., received by the Water-Works Trustees; Engineer, J. D. COOK, of Toledo, O.:

E. P. Allis & Co., Milwaukee, Wis.: (A) triple expansion engine, vertical type, cylinders 26, 45, 64 ins., 19-in. plungers, 48-in. stroke; $46,500 and $3,000 for foundations.—(B) engine of similar type and dimensions, but with cylinders 33⅓, 45, 45 ins., $43,000 and $3,000 for foundations.—(C) Vertical engine with three cylinders 24 ins. diameter, $40,000 and $2,500 for foundations.

Geo. F. Blake Steam Pump Co., Boston, Mass.: direct acting, duplex, plunger pump, 4 cylinders, 24 and 54 ins., 22-in. plungers, 48-in. stroke; $27,980, including foundations.

Knowles Steam Pump Co., New York; two bids for direct acting, duplex, plunger engines, 4 cylinders, 26 and 50¼ ins., 23¼-in. plungers, one 48 and one 36-in. stroke; $28,000 and $25,000, including foundations.

Deane Steam Pump Co., Holyoke, Mass.; direct acting, duplex, plunger engine, 4 cylinders 22 and 40 ins., 22½-in. plungers, 36-in. stroke, $19,500 and $1,500 for foundations.

H. R. Worthington, New York; direct acting, duplex, plunger engines; (A) four cylinders 25 and 50 ins., 19½-in. plungers, 36-in. stroke; $28,000; (B) four cylinders 21 and 42 ins., 19½-in. plungers, 36-in. stroke; $24,000 and $3,500 for boilers; (C) four cylinders 21 and 38½ ins., 20-in. plungers, 36-in. stroke, $17,825. These prices include foundations; $500 allowed for old engine.

Gordon & Maxwell Co., Hamilton, O.; two bids for direct acting, duplex, plunger pumps, four cylinders 26 and 46 ins., 22-in. plungers, 36-in. stroke, $18,000 and $1,500 for foundations, $1,500 for old engine; $19,500 and $1,500 for foundations, outside packed.

Holly Mfg. Co., Lockport, N. Y.; (A) Gaskill plunger engine, four cylinders 24 and 42 ins., 19½-in. plungers, 36-in. stroke, $27,500. (B) Duplex plunger engine, four cylinders 26 and 52 ins., 21½-in. plungers, 36-in. stroke; $21,400. (C) Similar type and dimensions, $24,250. (D) Vertical plunger engine, four cylinders 24 and 48 ins., four 21-in. single acting plungers, 36-in. stroke, $40,000. (E) Triple expansion vertical plunger engine, cylinders 22, 35 and 56 ins., three 21½-in. single acting plungers, 44-in. stroke; $37,500 and $3,500 for boilers. All prices include foundations.

National Iron Works, New Brunswick, N. J.; vertical, plunger, crank and flywheel engine; four cylinders 20 and 40 ins., four 12 x 20-in., and four 18 x 20-in. plungers, 40-in. stroke, $19,500 and $3,000 for foundations; $700 for the old engine.

Reservoir.—The contract for lining the reservoir of the Venango Water Co., at Franklin, Pa., has been awarded to F. Scandlon, of North East, Pa. The prices are $2 per cu. yd. for puddle, $2 per cu. yd. for sand, and $11 per M. for brick. The contract is estimated to amount to $30,000.

Bridge.—The following proposals for for an iron bridge at Avondale have been received by JAMES OWEN, C. E., Newark, N. J.: *Superstructure*; Smith Bridge Co., Toledo, O., $9,875, $10,200; King Iron Bridge & Mfg. Co., Cleveland; O., $10,175; Penn Bridge Co., Beaver Falls, Pa., $11,750, $12,250; Passaic Rolling Mills, Passaic, N. J., $13,685, $14,085; Canton Bridge Co., Canton, O., $13,750, $14,275, Dean & Westbrook, New York, $14,050; Riverside Bridge Co., $14,800, $15,220; Pittsburg Bridge Co., Pittsburg, Pa.; $15,200; Berlin Bridge Co., East Berlin, Conn., $15,880, $16,564; New Jersey Steel & Iron Co., Trenton, N. J., $19,069, $19,470. The contract was awarded to the Smith Bridge Co.——*Substructure*; A. R. Morrison, $13,990, for piling center pier $400, two next piers $600, two abutments, $550; J. W. Stagg, $12,287; A. E. Sanford, $17,180, $12,195 and $7 per pile. The contract was awarded to A. R. Morrison.

Dredging.—The following proposals for dredging in the Hudson river, between Troy and Coxsackie, N. Y., have been received by JAMES SHANAHAN, Superintendent of Public Works, Albany, N. Y.: Bath shoal; Lane & Brummelkamp, Syracuse, 25 cts. per cu. yd; E. M. Payn, Albany, 26⅝ cts.; Charles Brown, Mohawk, 31½ cts.; P. W. Myers, Albany, 34 cts.——Kellogg shoal; Lane & Brummelkamp, 25 cents; P. W. Myers, 30 cts.; E. M. Payn, 49.9 cts.——Fish House shoal; Lane & Brummelkamp, 25 cts.; P. W. Myers, 36 cts.; E. M. Payn, 28.9 cts.; Charles Brown, 35 cts.——Washington bar; Lane & Brummelkamp, 25 cts.; P. W. Myers, 30 cts.——Van Buren bar; Lane & Brummelkamp, 25 cts.; P. W. Myers, 38½ cts.; E. M. Payn, 49.9 cts. The contracts were awarded to Lane & Brummelkamp.

Cement.—The following proposals for 1000 barrels of cement have been received by the Docks Department, New York City: E. Thiele, $2.28 per bbl.; A. C. Babson, $2.40; Erskine W. Fisher, $2.40; Haebler & Co., $2.50. The contract was awarded to E. Thiele.

Bridge Contracts. — ***Marion, Ind.*** —The following proposals have been received for a wrought-iron bridge with two spans, 148 ft. between pin centers, roadway 20 ft. wide, two 6-ft. sidewalks; capacity, 2,000 lbs. on girders, 3,200 lbs. on floor system per lin. ft.: Variety Iron Works, Cleveland, O., $13,525, $13,755, $13,890, $13,985; Massillon Bridge Co., Massillon, O., $14,050; Indiana Bridge Co., Indianapolis, Ind., $14,300; Canton Bridge Co., Canton, O., $14,300; King Iron Bridge & Mfg. Co., Cleveland, O., $14,390; Motherwell Bridge Co., $14,670; Columbus Bridge Co., Columbus, O., $14,900; Pittsburg Bridge Co., Pittsburg, Pa., $14,945; Lomas Bridge Co., $15,000; Mt. Vernon Bridge Co., Mt. Vernon, O., $15,080; Smith Bridge Co., Toledo, O., $15,430; P. E. Lane, Chicago, $15,640; Champion Bridge Co., Wilmington, O., $15,845; Columbia Bridge Co., Dayton, O., $18,370. The contract was awarded to the Massillon Bridge Co.

Northville, Mich.—The Novelty Iron Works, of Buffalo, N. Y., have the contract for an iron highway bridge over the creek. The contract price is $14.15 per lin. ft.

Armourdale, Kan.—The contract for the construction of the 24th St. bridge over the Kaw has been let to the Kansas City Bridge & Iron Co. There are two alternative designs. The first is as follows: three deck spans, 200 ft. apart and one through span 160 ft. long, crossing the A. T. & S. F. tracks. This contract will call for $66,000. The second plan is as follows: three spans 200 ft. apart, with floor system lowered to grade on the A. T. & S. F. tracks. This contract will call for $59,000. The Kansas City Bridge Co.'s two bids were the lowest, and it is the option of the railroad company which way the bridge will be constructed. The commissioners have only $60,000 and they have asked the railroad company to appropriate $6,000 to carry the bridge over their tracks, which will do away with the use of a flagman, and probably will save a damage suit at some future time.

Austin, Tex.—The King Iron Bridge & Mfg. Co., of Cleveland, O., has the contract for the new bridge over the Colorado river at $47,000. There were ten bids, ranging from $44,000 to $58,000.

Street Lighting.—At Indianapolis, Ind., the following proposals have been received for lighting the city. The Indianapolis Gas Light and Coke Co., made three propositions:

First—We will light, extinguish and clean and keep in repair the public gas street lamps now in use (2,644) upon an annual schedule for 2,500 hours of three years from date for the sum of $39,560. Second—Or we will light, clean and extinguish, and keep in repair the same upon an annual schedule of 2,700 hours for a period of three years for the sum of $40,982 per annum. Third—We will light, clean and extinguish the above upon a schedule of 3,740 hours per annum for a period of three years from date of contract for the sum of $48,978.

The Thomson-Houston Electric Co., of Chicago, agreed to furnish 2,000-candle-power arc lights on the 2,500-hour schedule for $87 per light per year; or 2,000-candle-power arc lights on the 2,740-hour schedule at $90 per lamp per year; or 2,000-candle-power arc lights on the 3,750-hour schedule, or all night lighting every night in the year at $95 per lamp per annum. The company estimates that 500 lamps would light the city as well as it is now lighted, with electricity. It also agrees to furnish 65-candle-power incandescent lights for alleys for the sum of $40 per annum.

The Brush Electric Light Co., of Indianapolis, made the following proposition:

Five hundred or more 2,000-candle-power arc lights on 2,500-hour schedule, $81 per lamp per year; 500 or more 2,000-candle-power arc lights on 2,740-hour schedule, $85 per lamp per year; 500 or more 2,000-candle-power arc lights on 3,750-hour schedule, $98 per lamp per year.

The Jenney Electric Light Co., of Fort Wayne, bid as follows:

For a schedule of 2,500 hours, $37,500 per year.
For a schedule of 2,740 hours, $40,000 per year.
For a schedule of 3,750 hours, $42,500 per year.
Charge for any additional light ordered during time of contract, $62.50 per lamp.

This company also agreed to furnish light to cover all territory within the city limits, and place lamps at every street intersection at the following rates:

For a schedule of 2,500 hours, $39,000 per year.
For a schedule of 2,740 hours, $42,000 per year.
For a schedule of 3,750 hours, $45,000 per year.

WATER.

Water-Works.—***Maine.***—Boothbay. A meeting was held last Saturday to see if the town would vote to construct a complete system of water-works from Adams Pond to Boothbay harbor, for fire and domestic purposes and provide money for the same by issuing bonds or otherwise.

New Hampshire.—Franklin. The town has instructed the Water Committee to close a contract with the Franklin Water Co. for 50 hydrants at an annual rental of $1,500. Pipe laying will be commenced at once and it is hoped to have the works completed and in operation before winter.

Massachusetts.—Easthampton. The town has voted to appropriate $15,000 for a reservoir about a mile distant, to be supplied by springs on the side of Mt. Tom, and to furnish a gravity water supply.

Rhode Island.—Burrillville. The water question is still being agitated, but it is now proposed to take a supply from Herring pond or from springs near Pascoag.

New York.—Scholaire. A water company has been organized by C. O. KROMER and W. WHITING. Capital stock, $20,000.——Sandy Hill. Work is progressing on the pipe laying.——Franklinville. Water-works are projected, and a committee has been appointed to lay the matter before the Board of Trustees. The cost is estimated at $10,000 or $15,000.——Bath. At a recent meeting of the village trustees a petition was received from a large number of citizens requesting that a proposition be made to the Greenbush Water-Works Co. with a view of purchasing their plant in this village for the amount of $10,000 for which the property is assessed. The matter was referred to a committee.

Virginia.—Luray. Water-works are to be established. Address J. B. HUDSON.——Lexington. Next month pipe will be laid from a spring to the reservoir, 3½ miles, for the purpose of increasing the water supply; $18,000 has been appropriated. J. R. HOLMES, Superintendent.

West Virginia.—B. C. WASHINGTON has a franchise for water-works, and has had plans and estimates made. He proposes to organize a company and commence work at once.

Tennessee.—Brownsville. Water-works are to be built by J. W. Bates & Co., of New York. The supply will be taken from wells and pumped to a stand-pipe; there will be 5½ miles of mains. Estimated cost, $85,000.——Morristown. J. W Bates & Co., of New York, proposes to build water-works.

Illinois.—Springfield. The ordinance providing that the city council shall take entire charge of the water-works was reported favorably from the fire and water committee, and was laid over until the first meeting in next May by a vote of 8 to 4.——Alton. The Alton Water-Works Co. has increased its capital from $150,000 to $300,000.——Washington. An informal test of the water-works has been made. With tank pressure water was thrown 65 ft. The works will be formally accepted at the next meeting of the council.

Iowa.—Glenwood. The town will vote in a few days on the question of issuing bonds and building water-works, with a strong probability that the question will be carried.

Nebraska.—Sutton. The vote on the issue of $20,000 bonds for water-works has been carried by a large majority.

California. — Colton. The city has voted to issue bonds for the purpose of building water-works.——San Francisco. The Spring Valley Water Co. has nearly completed the works for bringing the water from Alameda creek.

Texas.—Galveston. Work is progressing on the wells and the pumping station for the new water-works.

Canada.—St. Sauveur, Que. The municipality wants to obtain a water supply from the Quebec water-works, but cannot settle on the price to be paid for the privilege.

Greensboro, N. C.—The water-works have been tested, and have more than fulfilled the contract requirements. Six 1-in. streams were thrown simultaneously to a height of over 100 ft. The material was furnished by R. D. Wood & Co., of Philadelphia, Pa. There are 9 miles of pipe, 75 hydrants and 60 gate valves; also a large wooden tank. Col. W. W. TAYLOR was the Engineer. The works have been accepted by the city by a unanimous vote of the council.

Caribou, Me.—The town has voted to accept the proposition of the Caribou Water Co., thus securing the building of a dam across the Aroostook river and the utilization of one of the best water powers in the State of Maine, which will give 1500 H. P. at low water. In connection with this the water company proposes to put in a first class system of water works, and establish a pumping station with a capacity of 1,000,000 galls. a day. The water will be thrown into a reservoir 100 ft. above the level of the village. The company will put in 25 hydrants for fire purposes, with drinking fountains for man and beast in public places throughout the village.

Allegheny, Pa.—The Wilbur filtering system, presented to the Water Board by Mr. LAHUGH, embraces two plans. One is to put three filters in at the foot of Herrs island, where the water will be purified before being pumped into the reservoirs; this would cost $375,000. The other proposes that the city furnish the pipe and the Wilbur flexible joint; this Mr. WILBUR will lay in the river, 3 ft. below the bottom, from Nine-Mile island to the water-works. To the first length of pipe there will be a strainer 6 ft. in diameter and 20 ft. in length. The cost, in addition to the cost of pipe, will be $25,000 a mile.

Burlington, Ia.—The water-works have been purchased by GEO. D. RAND, of Keokuk, Ia. The plans for the enlargement and improvement of the works have not been fully developed, but if a satisfactory agreement is made with the city 5½ miles of additional street mains will be put in. The city now has 18 miles. That would be a total of 23½ miles, and would give the city a good service for domestic and business purposes, and increases the efficiency of the protection against fire, as these extensions would include the usual proportion of fire hydrants. This additional service and fire protection can be had without any increase in the water tax and at an actual reduction to the individual taxpayer, as the extension of the water district would increase the number of water taxpayers. A better and increased water supply is contemplated, and a filter plant will probably be adopted. It is intended to give the works a capacity for double the present population of the city. An artesian supply may be adopted instead of filtering the present supply; an experimental well is to be put down, and if water is found it would be cheaper to use this supply than to filter the present supply. About 6 wells would be required, the cost of which is estimated at $30,000 to $35,000.

Meters, Water Waste and Revenue.—The Commissioner of Public Works, of New York, in his report ending Dec. 31, 1887, in discussing "Water Waste", says: "While a daily supply of 110,000,000 galls. of water has been received and distributed in the city, the increase in consumption of water has been such as to decrease the pressure in the delivery of water throughout the city about 4 ft. The supply cannot be increased until the New Aqueduct is completed and in operation, and in the meantime the department must provide for the needs of additional population and business by suppressing or diminishing waste of water. The most effective means to accomplish this is the extension of the water meter system. During the year 1,970 additional meters were placed, making 16,552 meters in use at the close of the year.

"The application of water-meters to buildings used in whole, or in part, for business purposes will be continued according to law."

A few comparisons between New York and other cities may help solve the problem, or at least suggest relief at a time when this is sorely needed. New York, with a daily consumption of 110,000,000 galls., receives $2,529,974 from this source. Of the total consumption 24,000,000 galls., or nearly 22 per cent., are passed through meters, and for this metered water the city receives $522,939. If the whole consumption was metered, at the same rate, the water receipts would be $3,657,506, or $1,127,532 more than at present. Providence, R. I., has 60 per cent. of its connections metered, and with a daily consumption of 4,909,982 galls. receives $339,513. On a similar basis with Providence, New York would have a revenue of $7,469,286. Fall River, Mass., has 73 per cent. of its connections metered, and receives $133,425 on a daily consumption of 1,590,000 galls. New York would have $8,972,900 on the same footing. Meters not only increase the revenue from water, but also—which is more important to New York in its present needs—check waste, and by checking waste raise the pressure on the mains; just as Rochester, N. Y., last summer, increased the pressure on the mains 5 lbs. by placing 500 water meters. Chief Engineer BIRDSALL, of New York, says: "The placing of meters stops waste. First, by the parties knowing they have a constant watch on their use of water; second, by the owners changing their old-fashioned plumbing; and third, by showing when there are any leaks on the premises."

Water Famine.—Jeffersonville, Ind., has been suffering from a scarcity of water; many cisterns and wells being dry.

Springer, N. M.—The Springer Water Co. has been organized, with a capital stock of $25,000, to supply water for domestic, fire and irrigation purposes. President, Hon. M. W. MILLS; Vice-President, P. P. TALLE; Secretary, Capt. HENRY STURGES; Treasurer, EDWARD CLONTHIER; Board of Directors, D. A. CLONTHIER, HARRY GARRETT, CHARLES MARKS, P. P. TALLE, M. W. MILLS, EDWARD CLONTHIER, HENRY STURGES, N. FORTIN, M. M. SALAZAR, R. H. COWAN, JOHN C. TAYLOR, ROBERT STEPP and D. D. DOMAS. W. W. JACOBS was appointed Superintendent, with instructions to gather all necessary data as to prices of machinery, pipe, etc., make the required surveys and prepare plans, specifications and estimates.

Grand Rapids, Mich.—The Grand Rapids Hydraulic Co. is now supplying water through its mains. The pumping machinery was started and the works tested early in June, and regular service was commenced June 14. The mains are laid on all the streets down town and in many parts of the hill region and other residence portions of the city. The company has now 8 miles of mains of different sizes and has contracted for 5 miles more, which will probably be laid this summer. The old wooden mains of the company on the gravity system are not strong enough for the pressure of direct pumping and will be replaced with iron pipe. There are two pumps furnished by the Geo. F. Blake Mfg. Co., of New York; the one for regular service is a duplex compound low pressure condensing engine, and the other, which will be held in reserve, is a high pressure engine. A 12 in. iron suction pipe connects with a well 150 ft. distant. The well is of masonry, with an iron shoe resting in the gravel; it is 20 ft. deep, and 30 ft. in diameter; it is supplied by springs and has 14 ft. of water; it is estimated to supply 1,000,000 gallons per day, and when necessary additional wells can be sunk, or a gallery run into the spring land which extends several miles up the river. The foundations for the stand-pipe are completed, and the pipe will be erected soon.

From the well the water is pumped into a 12-in. main which runs down Ionia St. to Louis St., a distance of nearly 3 miles. From this main the water is distributed generally. The water is pumped only into the iron mains, the old wooden pipes being supplied as heretofore by gravity from the Penney and Kusterer springs. The pressure on the hill even is strong enough to send a stream over a large dwelling house.

Water Filtration.—MR. NISBETT WINGFIELD, Superintendent of Water Works, Chattanooga, Tenn., has written the following with regard to the operations of cleaning the plant put in by the National Water Purifying Co., of New York.

"Having made a thorough test of the National Filter Plant I find that it will readily purify 3,000,000 galls. per day; in fact the ten No. 17 filters gave 4,000,000 galls. of Tennessee river water, in 24 hours, removing all suspended matter and impurities, and rendering the water clear and bright. In washing the filters they are arranged to wash two at once, doing away with the necessity of operating one set of valves. Each battery of two filters takes but 24 minutes in cleaning, or 2 hours to thoroughly wash the entire plant of ten filters, using a 4-in. pipe in washing, under 45 lbs. water pressure, thus making the plant very economical in time and water in cleansing. There is a bed 5 ft. deep of Long Island sea sand in each filter. This sand is entirely without crevices and can be thoroughly cleansed by a reverse current. In washing the filters, the top of the bed, say 6 to 12 ins., is washed first, as most of the impurity taken from the water in 24 hours is lodged on the surface of the sand bed. Four minutes' flow of water will answer for the surface washing; then a reverse current is sent through the bottom of the bed which breaks it up and throws out all of the finer particles in the lower part of the sand bed. No labor is required in the process of washing, the pressure of the water alone accomplishing, by the reverse current, a thorough cleansing of the sand bed in the filters, the only labor necessary being to open and close the valves in the pipes once each day, which requires no skill."

The question of filtering large quantities of water for public supply is an important one, especially in the South, where the majority of the rivers carry considerable sand and mud in suspension; and where a large filter plant is put in, the proper and effectual cleansing of the filtering medium is one of the principal points in the general efficiency of the system.

Lincoln, Neb.—Owing to the brackish water supplied by the driven wells from which so much was expected in the way of a water supply, various propositions have been made to obtain water from the Platte or Missouri rivers. The Water Committee, however, think that there is an abundant supply of good fresh water under the city and are putting down new wells to depths of 28 and 35 ft. instead of 50 ft., which is the depth of the salt water wells. The Burlington & Missouri River R. R. Co. has a 40 ft. well near these latter wells, and has been pumping a supply of fresh water for several years, and it is thought the present experiments will result satisfactorily. L. L. LYMAN, Water Commissioner, has made a long report to the City Council on the water supply, reviewing the proposed sources of supply. The estimates of cost of two of these projects may be summarized as follows: Platte river, including gravity canal, dams and bulkheads, $715,000; Blue river, $662,600. He favors a thorough trial being made with the new wells, the cost of which system is estimated as follows.

Collecting main, 600 ft. of 20-in. pipe	$ 800
Shafting and fittings	320
Settings for shafting	600
Fly wheel and gears	100
Engine and boiler, 40 H. P.	1,000
Boiler house	300
Concrete bottom in old well	1,000
One hundred wells	3,000
Total estimate for new wells, overhauling and new machinery	$7,120

The cost of each new well he estimates as follows:

1 copper point	$8 00
18 ft. of 2-in. galvanized iron pipe	3 00
Check valve, plunger rod, tee and stuffing box	4 00
Digging pit 13 ft. deep	3 50
Connecting to flume	2 00
Curbing pit	5 00
Driving well	3 00
Total cost of one well	$29 40

The cost of 100 wells as above would be in round numbers $3,000.

Artesian Wells.—*Alexandria, La.*—The City Council has appropriated $500 for the purpose of aiding the boring of an artesian well in the city for fire and other purposes. The parish has also made an appropriation for the same purpose.

New Orleans, La.—The Southern Artesian Well Co. has been 4 weeks sinking a 4½ in. artesian well on the banquette in front of the premises of the Consumers' Ice Co. A flow of 50 gals. per minute was struck at a depth of 702 ft., but 100 gals. per minute is expected to be obtained.

Corinth, Miss.—The City Council is having a number of artesian wells put down.

Galveston, Tex.—J. W. Byrnes, contractor, has put down an artesian well 822 feet deep at the cold storage building. It is being continued. Contractor Seigel is putting the city well deeper down, having failed to obtain a supply at 480 ft.

Houston, Tex.—J. W. Byrnes, of Galveston, has contracted to put down two artesian wells. A supply of 16-in. pipe has been shipped from the National Tube & Iron Works, Philadelphia.

Pueblo, Col.—The Pueblo Oil & Artesian Well Co. has elected the following directors: G. L. NASH, CHARLES REITER, K. WILDEBOOR, WARD RICE, J. HUGHES, J. S. THOMPSON and C. H. SMALL. This company has bored four artesian wells in the past eight months and is now boring one 600 ft. deep, at Columbia Heights.

Pasco, Wash. Ty.—The artesian well commission appointed in accordance with the act of the last legislature providing for the sinking of artesian wells in Adams and Franklin counties, have decided to bore one of the wells at Pasco.

Lemoore, Cal.—An artesian well 600 ft. deep has been bored two miles from Lemoore. It has a 4-in. flow, and the volume of water is increasing.

Ogden, Utah.—An artesian well is to be put down to test for a water supply.

Special Reports of Water-Works Construction.

THE ENGINEERING NEWS MANUAL OF AMERICAN WATER-WORKS is now being compiled, and will be *indispensable* to every manufacturer, engineer and contractor in any way interested in Water-Works construction and maintenance, and will be of great value to Water Works superintendents and projectors of new works.

Superintendents of water-works and water companies will wish to see correct and complete data concerning their Works in our MANUAL, and to ensure this they should send in reports *at once* upon the blanks which we have already sent to every Water-Works office in the United States and Canada. Many have delayed their report, and if the blanks we intended for them have been lost in the mail, or mislaid, we will send more upon request.

We *must* have a report from every public water-supply system in North America, so those who reply to our inquiries at once will save a second inquiry. We also wish to know of *every* new Water-Works plant in process of construction, and of *every* new project in this line. We will send to any one desiring them, blanks upon which reports can be made.

Further details of the MANUAL will be advertised later. We abstract from our special reports for the MANUAL the following items of current interest:

GILDERSLEEVE, Conn., July 10, 1888.

EDITOR ENGINEERING NEWS:—A charter for water-works at Portland, Conn., has been obtained, but a company has not yet been organized. We are waiting for some one familiar with the business to take the charter and build the works. Water will be taken by gravity from a mountain stream. The town has voted for hydrants, and a canvass of the people warrants an estimate of $5,600 as the first year's revenue from the works. The population of Portland is 4,500.

A. GILDERSLEEVE.

FRANKLIN, N. Y., July 4, 1888.

EDITOR ENGINEERING NEWS:—It has been proposed to sink an artesian well here and pump water to a reservoir for domestic use and fire protection. D. A BETTS is President of the water board. Population, 1,000.

GEO. T. TILTON, *Secretary.*

NEWARK, N. J., July 15, 1888.

EDITOR ENGINEERING NEWS:—A $50,000 system of water-works has been projected for Watkins, N. Y.; water to be pumped from Seneca lake to a reservoir, also directly to the city. The city will probably build the works eventually, although at a recent special election the proposed improvements were voted down. The present officers remain in power four years. FRED DAVIS, Jr., being President. The population varies in winter and summer, ranging from 5,000 to 6,000.

CARROLL P. H. BASSETT, *Engineer.*

LYNCHBURG, Va., July 10, 1888.

EDITOR ENGINEERING NEWS:—The Norfolk & Western R. R. Co. propose to put in water-works at Crewe, Va., pumping the water to the tank from a small creek. The system will cost $12,000. GLAMORGAN CO., *Contractors.*

CULBERTSON, Neb., July 7, 1888.

EDITOR ENGINEERING NEWS:—Bonds to the amount of $4,000 have been voted by the town, and specifications are being drawn for a system of water-works to supply this place. Water will be pumped from wells to a tank. Contracts will be let Sept. 1. Population, 800.

L. E. CREWS.

SUTTON, Neb., July 7, 1888.

EDITOR ENGINEERING NEWS:—Bonds for a system of water-works were voted by this town July 6. Water will be pumped from a well to a stand-pipe at a cost of $20,000. Contracts will be let Aug. 1, and the works finished Dec. 15. E. N. WOODRUFF can give further information. Population, 2,000.

F. C. MATTESON, *Chairman Water Board.*

LONOKE, Ark., July 2, 1888.

EDITOR ENGINEERING NEWS:—We have no plans yet, but will have water-works if the cost is not more than $2,000. Our population is 2,000. Dan. Daniels is chairman of the Water Board. C. M. WITHINSON.

RECORD OF NEW WATER-WORKS CONSTRUCTION.

(Specially Communicated.)

(CONTINUED FROM PAGE 38).

West Randolph, Vt.—The works were commenced in April, 1887, and completed Sept. 12, 1887. They were designed by JOEL FOSTER, of Montpelier, Vt., who was also Constructing Engineer. The buildings were put up by the village; the pipe was furnished by the Warren Foundry & Machine Co., of New York, and the valves and hydrants by the Ludlow Valve Co., of Troy, N. Y. The supply is by gravity, the water being taken from springs and brooks in Braintree, 2¼ miles from the village; there is a reservoir about ½ a mile from the village with an elevation of 243 ft. above Main St.; its capacity is 1,000,000 galls. The mains are of cast-iron, and the services of wrought-iron. There are 5½ miles of pipe, 34 hydrants and 140 taps. Ordinary pressure, 105 lbs. Cost of works, $22,000; debt, $22,000; rate of interest, 4 per cent. Annual operating expenses, $300. Annual revenue from consumers, $1,200. The works are owned by the village, and are managed by a board of Water Commissioners, of which WM. H. DU BOIS is Chairman. The rental per hydrant is $15; the village pays the Water Department. LEMUEL RICHMOND is Superintendent. The present population is 1500. The Commissioners are WM. H. DUBOIS, WM. B. VIALL, A. A. SMITH, L. RICHMOND and CHAS. E. ABBOTT.

Defiance, O.—The works were commenced Oct. 17, 1887, and are to be completed by Sept. 1, 1888. They were designed by ELLIS MORRISON, of New York, who is also Constructing Engineer. The contract for the works complete was awarded to SAMUEL R. BULLOCK, of New York; the pipe and specials were supplied by Dennis Long & Co., of Louisville, Ky., and the valves and hydrants by the Ludlow Valve Mfg. Co., of Troy, N. Y. The supply is drawn from the Maumee river and pumped to a stand-pipe 140 ft. high and 22 ft. diameter by two compound condensing engines with an aggregate daily capacity of 4,000,000 galls. There are 12.8 miles of pipe and 130 hydrants; the mains are of cast-iron, and the services of wrought-iron and lead. The rate of interest is 6 per cent. Annual revenue for the city, $5,200. The works are owned by the Defiance Water Co:, capital stock, $200,000; bonds, $200,000. President, DENTON M. DURYEA; Secretary and Treasurer, E. F. FULLER. The franchise is for 30 years, and the hydrant rental is $40 per hydrant per annum. Present population, 8,500.

TO BE CONTINUED.